Bargaining over Maternity Pay: Evidence from UK Universities *

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Abstract

The generosity of maternity pay has been shown to be an important factor for mothers' attachment to the labour market. In the UK we can observe that the generosity of maternity leaves across universities varies greatly: some universities top up the statutory maternity pay with longer and better paid leaves, others are either less generous or only entitle academic women to the legal minimum. We want to understand why this is the case. Therefore, this paper examines both theoretically and empirically how higher education employers decide about the generosity of the offered occupational maternity pay. We use a bargaining approach to model the supply and demand side of generous maternity benefits in universities with different characteristics and test the implications with a generalized negative binomial model. We find that universities' income does not account for this variation while differences in terms of costs and benefits for employers do. Most importantly, our results show that more research intense universities with a higher previous share of female professors provide more generous maternity pay. We offer a range of explanations for these findings.

Keywords: maternity benefits, policy determinants, women in academia, bargaining, economic costs

1 Introduction

How are HR policies decided in academia and by extension in high skills sectors? In this paper, we use a bargaining framework to explain one particular HR policy, maternity leave generosity across UK universities.

The importance of maternity and childcare entitlements has been widely acknowledged by both scholars and policy-makers: evidence shows that well paid, non-transferable and flexible provisions with respect to maternity and child care-giving mitigate the "baby penalty" women face in the labour market and help reducing gender inequalities both in the household and at the workplace (Farré 2016; Kleider 2015; Mandel and Semyonov 2006; Gornick, Mayers, and Ross 1997). Many OECD countries have embarked on a number of changes of parental leave policies in the last decades [1], particularly in Europe, under the homogenizing pressure of the European Union. Yet, and despite these legislative changes, the generosity of parental leave entitlements varies significantly not only across countries but, within a country, also across and within sectors.

Why, despite pressures, do we still observe a large variation of maternity provisions? To shed more light on this issue, we focus on one sector in a single country, where data are available, namely the Higher Education sector in the UK. This has multiple advantages. First, detailed data on maternity provisions exist for the entire universe of institutions in this sector. Second, the academic environment is characterized by human capital as main input, reducing the influence of unobservable characteristics, such as production technology. Third, there exists an independent measure of the quality of British higher education institutions provided by the Research Excellence Framework based both on research outputs (e.g. publications, performances, and dissemination) and the impact beyond academia of the research produced. This assessment allows to gauge the impact of institutional quality on Human Resources policies, at least in the context of the UK university sector.

We analyze 214 maternity schemes across 160 Higher Education Institutions (HEIs) in the UK and show that there is a significant variation in the generosity of maternity leaves even in this sector: only 7 universities entitle mothers to up to 6 months of full salary replacement, many universities grant only 4 weeks of fully paid leave while some institutions offer no maternity provisions on top of the statutory entitlements.[2] In addition, there is also a stark variation between maternity schemes and eligibility criteria, with staff on fixed-term contracts, such as researchers and teaching fellows frequently excluded from most of the occupational maternity schemes provided on top of the statutory provisions.[3]

We employ a bargaining model to explain this significant variation in maternity provisions across UK universities. In a bargaining framework, factors that enhance the negotiating position of female employees are associated with more generous maternity packages, whereas features that increase the bargaining strength of employers are associated with lower generosity. As a result, our theory predicts that universities with higher shares of unionised employees, those with a larger proportion of female professors, and institutions which put greater emphasis on research offer better maternity provisions. In contrast, universities with higher student-to-staff and admin-to-academic ratios grant less generous policies. According to our model, universities' income plays a very limited role in explaining the generosity of maternity policies.

The bargaining framework performs relatively well in the data. Most of our predictions are empirically supported. In particular, universities' income has no effect on maternity generosity. The only exception is the level of unionisation, which is statistically insignificant. This might be due to the fact that unions have many constituencies, which are not all concerned with maternity policies. We also show which universities – given their characteristics – over- or underprovide in terms of maternity and childcare benefits.

Our research contributes to the wider literature on gender equity in childbearing and rearing entitlements and capabilities. Many scholars in this literature analyse the institutional channels of agency inequality between mothers and fathers in taking childbearing and caring decisions and highlight the role that institutions play in shaping human capabilities (Hobson et al. 2011; 2006; 1997, *inter alia*) . We add further evidence of a large variation in the institution-based constraints and incentives that hinder or enhance the effective possibility to exercise parental and childcare entitlements in a human capital intensive sector, the UK academic sector. Our research also contributes to the larger debate on women's under-representation in qualified and competitive sectors by examining the structural conditions that encourage maternity and child caring across UK higher education institutions.

Our paper is structured as follows: in the next section, we place our research within the wider theoretical and empirical literature on maternity and parental leave provisions. In the third section, we present a parsimonious and stylized bargaining model to illustrate our main hypotheses on the variation on maternity and childcare benefits across UK higher education institutions (HEIs). Data, variables and research design are presented in the fourth section. We discuss our findings and the robustness of our empirical analysis in the fifth section while the final section concludes and points to future research avenues.

2 Parental Leave and Work-Life Balance Policies in Organizations

This paper speaks to a wide range of theoretical and empirical research on maternity and parental leave provisions. Many papers in this literature stress the importance of considering both length and generosity in designing maternity arrangements. As for length, empirical evidence suggests a U-shaped relationship between the duration of maternity leave and women participation in the labour force (Akgunduz and Plantega 2013; Genre, Salvador and Lamo 2010; Pettit and Hook 2005). Very long or too short leaves are associated with a lower share of working women but, at middling levels, maternity leaves increase retention of mothers in the workforce.[4] Long leaves, however, generate cascade effects on several other dimensions as they typically translate in lower levels of work experience, higher chances of career interruption and lower levels of productivity, thereby reducing the incentives for the firm to invest on mothers on leave (Del Rey, Racionero ad Silva 2017; Ulker and Guven 2011; Genre et al. 2010; Albrecht et al. 1996).[5]

In contrast to these works, our paper focuses on the generosity of maternity leaves rather than the length which is fully determined by statutory provisions. Well paid maternity benefits with high replacement incomes[6] are consistently associated with higher employment and retention rates of mothers and higher levels of well-being and job satisfaction of women employees; scarcely paid or unpaid leaves correspond to having no leave at all.[7] We analyse the variation in the generosity of occupational maternity pay, and borrow from this research, three measures of maternity scheme generosity – namely, full week salary replacement; number of weeks for which salary replacement is granted, either fully or partially; and the so called full weeks' equivalent, which estimates the full monetary value of the paid maternity benefits. We complement this literature by documenting a large variation in the generosity of maternity leaves even in a relatively homogeneous sector, the UK university sector.

Our paper also intersects with the wide research on work-life balance provisions in organizations. Like our own, many papers in this literature link the variation in maternity policies to firms and organizations' characteristics and find that size, the composition of the workforce and the share of women in executive positions are likely predictors of generous maternity provisions both in for-profit and non-profit sectors (Pitt-Catsouphes et al. 2004; Galinsky and Bond, 1998; Konrad and Mangel, 2000, Evans 2001, Secret et al. 2000).[8] Unlike these papers, however, our research shows that universities' budgets and financial resources have little effect on the provisions of generous maternity benefits. Scholars in this literature, moreover, examine the business benefits and the costs of work-

life balance policies across sectors and in a cross-country perspective (Yasbek 2004, White et al. 2003). In contrast, our research focuses on a relatively homogeneous environment within a single country, which allows identifying local causal effects conditional on the specific context, but cautiously extendible to high-skills and competitive sectors.

In this sense, our paper is in closer conversation with the "capabilities approach" to work-life balance, which emphasizes the institutional context and the extent to which institutions allow converting rights and entitlements into *de facto* opportunities to exert them (Hobson et al. 2011, 2009, 2006, 1997; Gregory and Milner 2009; Lewis 2009; Bovin et al. 2009; Dean et al. 2005).[9] Likewise, a host of theoretical and empirical papers explores the variation in the generosity of social policies through the lenses of institutions and welfare state regimes and the type of incentives provided to workers in liberal versus coordinated market economies (Iversen and Rosenbluth 2006; Estévez-Abe 2006; Soskice 2005; Misra 1998; Lewis 1992). Our research establishes and provides some explanations for the large variation in maternity provisions within a country, the UK, where "reconciliation" policies until 1997 have been traditionally left to the initiative of the private market,[10] and within a single homogeneous sector, the higher education system.[11] In doing so, we add higher internal validity to our findings and advance the likely determinants of maternity generosity in a skilled environment, which cross-sectors and cross-country comparisons are unlikely to capture.

3 Variation in Maternity Provisions across UK Universities: A Bargaining Framework

We explain the variation in maternity leaves across UK universities within the framework of a bargaining model (Binmore, Rubinstein, Wolinsky, 1986), which, we believe, is able to capture the employees-employers' dynamics in the context of Higher Education Institutions in the UK (we provide a stylized formalization of our framework in Appendix A).

Changes in occupational maternity pays across HEIs are proposed by Human Resources teams, which review the existing provisions and suggest potential changes to the relevant university bodies (council, senate, management teams). Occupational maternity benefits in the UK university sector are usually changed concomitantly with changes in statutory provisions or when the government promotes gender oriented activities (such as the Athena Swan or Gender Equality mark programs).[12] The rationale for policy changes is grounded among others, on the following considerations[13]: the current bene-

fits for recruitment and retention of staff; the feedback from employees (generally through surveys); consultation with relevant groups of staff members (for example, female professors); recommendations raised by programs advancing gender balance such as Athena Swan (this is more recent); benchmarking to peer universities or institutions in the public and civil service sectors; and finally, a cost-benefit analysis for the sustainability of the proposed changes.

In a nutshell, maternity leave provisions result from implicit or explicit negotiations between the organization board and the bargaining units representing the workforce. In the context of UK universities, the two sides involved in this bargaining process are the university management and the female employees. Within this framework, we obtain clear predictions. First, factors which raise the bargaining power of women employees, especially academic women, increase maternity benefits. Second, determinants which increase the cost of providing maternity benefits reduce the generosity of maternity provisions.[14] Finally, factors that increase the institution's incentives to retaining mothers in the workforce will also increase the generosity of maternity pay. From the onset, let us stress that most of our results carry through if we only focus on the university's cost-benefit analysis (indeed, the formal model shows that a cost-benefit analysis is a special case of our framework). The only exceptions are factors that enhance the bargaining position of employees which play no role then.

3.1 Maternity Benefits in Academia: Bargaining Power of Mothers

We posit that one specific condition is likely to affect the bargaining power and the weight of women in this negotiation process and this is the number of female full professors.

Arguably, women in higher academic positions are more likely to influence the policy choices set at university level given that full professors participate in academic committees which decide on policies and strategies. Since women have a vested interest in better work-life-balance provisions, we argue that a larger share of female professors involved in university policy making, positively affects the generosity of occupational maternity packages.

Second, trade unions usually pursue better work-life balance and parental leave policies and push for these types of policies to be implemented and improved by employers. The University and College Union (UCU) in the UK in general is concerned with employment conditions of university staff in the UK higher education sector. The UCU more specifically aims at implementing better work-life balance policies within UK universities and thereby follows a strategy jointly developed with the German Education

Union (GEW), and the Swedish Association of University Teachers (SULF)[15]. Given this stated goal we expect more unionised universities, i.e. higher education institutions with a higher union density, to be better able to negotiate more generous maternity leave policies.

This allows deriving the following hypotheses:

H1: *The larger the previous share of female full professors in a university, the more generous is the provision of maternity policies.*

H2: *The higher the union density in a university, the more generous is the provision of maternity policies.*

3.2 Maternity Benefits in Academia: Costs for Employers

Along with the conditions that increase the bargaining power of female academics, the decision to grant generous maternity provisions depends also on the costs that these policies impose on the employing institution. We identify three likely restraints: financial resources, workforce composition (academic-to-admin ratio), and student-to-staff ratio, which we discuss in turn.

One intuitive difference between higher education institutions rests on their financial resources. Some universities are richer than others and can grant more generous leaves to their employees. Yet, university income comes into play only if the costs of maternity leave provisions hit the university's budget constraint (i.e. the costs are higher than the resources the university can reasonably allocate to maternity benefits, which then, and only then, become a function of the university budget). Therefore, we expect the effect of greater financial resources to be only weakly positive.

A second factor likely to affect the costs of providing favourable maternity schemes is the academic-to-admin ratio. The levels of education, training, qualification and skills required for administrative tasks are arguably lower than those necessary to become an academic. While differences in skills and qualifications usually translate into different salary schemes, institutions cannot discriminate female academics and female support staff in granting maternity provisions (and rightly so). We posit that universities employing a higher number of female academic staff (to total members of female administrative staff) are likely to grant relatively less generous maternity policies. As for retail, construction and wholesale industries, the presence of less qualified workforce in universities with a higher proportion of support staff is likely to push up the maternity benefits granted to female employees because salary replacement in this case is cheaper. We therefore expect

that the generosity of maternity arrangements is likely to decrease as the ratio between female academic and administrative staff increases.

Indeed, the skill specificity of academic jobs is much more pronounced than for administrative jobs. An administrator in a biology department can relatively easily move across to a similar job in the Humanities or Social Sciences while a sociologist can hardly do the job of a biologist. Also, it is costlier for the universities to invest in skills and productivity of female academics than female administrators. Comparing the sheer numbers of female academics and administrators, the supply female academics (particularly at senior levels) is much lower. It is therefore harder to replace academic mothers not returning to their job after maternity than mothers with administrative duties. We therefore posit that the bargaining process is geared toward female academics, especially at child bearing age, much more than towards female administrators. For this reason, we expect that the generosity of maternity pay is not influenced by the share of senior female administrators or female administrative staff at child bearing age.

Finally, we argue that the costs of maternity allowances increase with higher student-to-staff ratio across universities. If we assume that teaching, admin, pastoral care and supervision duties are equally shared among members of staff, as the student-to-staff ratio increases, that is, the number of students per academic member of staff becomes higher, the absence or leave of any academic member generates externalities, in terms of higher workloads, for all the remaining ones. By way of example, suppose there are 20 students allocated across 10 members of staff. If one member leaves, the costs for the remaining member of staff, in terms of workload, are negligible compared to a case where 20 students have to be re-allocated across 4 members only. In this latter case, each academic member becomes highly indispensable and generous leave policies become costlier in terms of re-allocation of pastoral, teaching and supervision tasks among other academics. We expect that universities with a higher student-to-staff ratio are therefore less generous in granting maternity leaves compared to universities with lower student-to-staff ratios.
We draw the following hypotheses:
H3: *The larger the universities' budget, the more (weakly) generous is the provision of maternity leave policies.*
H4: *The higher the academic-to-admin ratio, the less generous is the provision of maternity leave policies.*
H5: *The higher the student-to-staff ratio in a university, the less generous is the provision of maternity leave policies.*

3.3 Maternity Benefits in Academia: Retention of Academic Staff

Our discussion of the determinants of maternity provisions across higher education institutions in the UK has identified a number of factors that are either likely to increase the bargaining power of women in academia (i.e. number of female professors) or to increase the costs of generous provisions across institutions (i.e. university income, academic-to-admin ratio and student-to-staff ratio).

There is, however, an additional factor, ingrained in the UK academic system, which affects both women's bargaining power and universities' incentives to retain productive mothers, that is the research intensity of the institution as measured for example through the REF – Research Excellence Framework[16]. The REF is a process of expert review, which assesses the quality of the outputs, the impact and the environment of the research produced in the UK higher education institutions. REF scores serve both as benchmarks for the allocation of public investments in research activities and as indicators of the quality of research carried out across British universities. Higher scores in the REF entail a larger amount of funding and higher reputational returns for the academic institutions. [17]

We argue that research intensity is an important predictor of the generosity of maternity policies offered to women in academia for two reasons. First, research intensive universities are equipped with screening and recruitment mechanisms that select high-quality and highly productive academic profiles (researchers who publish four-star or three-star articles, to use the language of the REF), or high-impact scholars. Given the high costs of recruitment, highly ranked universities have greater incentives to retain productive scholars by "attracting"them with additional benefits such as more generous maternity provisions. Second, highly productive academics are also more likely to be poached by competing universities and to obtain outside offers, which increase their bargaining power. Both effects lead to the same predictions, namely that research intense universities have more generous maternity policies in place than less research oriented academic institutions in order to retain highly productive mothers.[18]

We derive the following final hypotheses:

H6: *The higher the research intensity of the university, the more generous is the provision of maternity leave policies.*

H7: *The higher the share of female academics at child rearing age, the more generous is the provision of maternity leave policies.*

3.4 Summary of Hypotheses

We expect the generosity of maternity leaves across UK universities to increase as the bargaining power of academic women increases and the relative costs of maternity pay decrease. Women's bargaining position is expected to be higher in unionised universities and those with higher shares of female professors. The costs of granting favourable maternity policies are likely to depend on academic-to-admin ratio and student-to-staff ratio, while the institution's income is expected to have a limited effect on maternity leave generosity. Finally, we predict that maternity leaves are more generous in institutions with a higher share of female academics at child bearing age and research oriented universities, where academic women have more bargaining power and the costs of generous policies are offset by the higher returns of hiring highly productive researchers.

4 Data and Empirical Analysis

4.1 Maternity Leave Policies across UK Universities

Maternity and parental leave policies have a twofold aim: to sustain the well-being of women before and after childbirth by entitling them to take time off from working without losing their jobs (maternity length); and to ensure financial support to mothers and parents during their period of protected leave (leave generosity).

In the UK, women employees are entitled to Statutory Maternity Pay (SMP) if they have worked for the same employer continuously for at least 26 weeks up to the 15th week before the expected week of childbirth and they earn on average at least 109 GBP a week. Women that qualify for the SMP get 90 percent of the average weekly earnings (before tax) for the first 6 weeks and the lower of 140.98 GBP or 90 percent of the average weekly earnings for the next 33 weeks.

Given the meagre benefits granted through statutory maternity pay to women in the UK (as compared to other European countries),[19] most UK universities provide Occupational Maternity Pay (OMP) that tops up the Statutory Maternity Pay in the first 39 weeks of maternity leave. The eligibility criterion to access the OMP usually depends on the length of service and both the payment and the eligibility criteria vary across institutions. For example, the University of Liverpool's OMP, regardless of the length of service, allows for full salary replacement for the first 8 weeks, half salary plus the SMP rate for the next 16 weeks and only the SMP for the last 15 weeks of ordinary maternity leave. The London School of Economics and Political Science instead grants full salary replacement for the first 18 weeks and the SMP (at the lowest rate) for the last 21 weeks, if the

woman has been employed for at least 26 continuous weeks before the expected date of childbirth.

Other universities may offer 2 or more different OMP schemes that either depend on the length of service of the employee (in such cases the employee cannot choose the OMP she prefers), or may not depend on eligibility criteria and the employee is free to choose between different salary replacement schemes. For instance, at the University of Durham women can choose, if they satisfy the unique eligibility criterion, the salary replacement scheme they prefer during the ordinary maternity leave period.

There are two types of schemes in cases where universities offer more than one occupational maternity package. Type one consists of HEIs offering different maternity packages where one is more generous in terms of salary replacement than the other. This depends, usually, on different eligibility criteria, e.g. longer service is required for the more generous package. Type two involves HEIs offering different packages that are roughly similar in terms of monetary value but entail a trade-off between salary and time, namely between a higher level of salary replacement for a shorter period of time and a longer but less paid leave. The choice between the two packages is usually not determined by different eligibility criteria.

Only 30 out of the 160 HEIs, for which data on occupational maternity benefits was available, offer more than 1 package - usually 2. Only 8 of the universities with different packages have different eligibility criteria for the different schemes; typically, they require a longer period of service to become eligible for more generous maternity pay[20]. In the other 22 cases the two (or more) schemes require the same length of prior employment and have the same monetary value but the maternity pay is split up into different periods with full or partial salary replacement, e.g. 8 weeks of full pay plus 16 weeks of half pay vs. 16 weeks of full pay (e.g. University of Warwick).

4.2 Measuring Generosity

Arguably the best indicator for the generosity of maternity benefits is the number of weeks for which full salary replacement is paid. On the one hand, if women can take more time out of work – without income cuts – they are certainly advantaged in terms of adapting to their motherhood status without being pressured by income concerns or the need to multi task administration, teaching and research activities. This increases the probability that women return to their research position without having to take a career break and with possibly minor effects on research and publication activity. On the other

hand, salary replacement represents the costliest part of maternity packages for universities.

A look at generosity of maternity pay across British HEIs reveals a large variance across universities which cannot only be explained by different financial constraints faced by the university. We collected data on occupational maternity provisions for 214 different packages across 160 different UK HEIs.[21]

Table 1 gives a summary of our main measure of generosity – weeks with full salary replacement[22].

Weeks full salary replacement	Number of packages	%
0	15	7.0
4	51	23.8
6	27	12.6
8	38	17.8
9	5	2.3
10	1	0.5
12	3	1.4
13	9	4.2
14	2	0.9
16	14	6.5
17	1	0.5
18	37	17.3
19	1	0.5
20	3	1.4
26	7	3.3
Total	214	100.0

Table 1: Generosity of OMPs across UK HEIs

As Table 1 shows, there is a significant variation in the generosity of maternity leaves across UK universities: 15 packages do not top up statutory pay, a large number (51) of provisions grant up to 4 weeks of full pay, and only 7 HEIs provide mothers with up to 6 months of full salary replacement. The number of weeks for which full salary replacement is granted to women on maternity leave varies from 0 – or just statutory maternity pay (e.g. Leeds Metropolitan University) to 26 weeks (e.g. Manchester University). Places as diverse as Bristol, Kent or Goldsmith College only grant 8 weeks of fully paid maternity leave compared to the 18 weeks of full salary replacements provided by Keele University or Cambridge University, *inter alia*.

From the collected raw data, we also calculated slightly different measures of generosity for robustness purposes. First, we looked at the number of weeks for which salary replacement is granted, either fully or partially. This variable does not necessarily provide a good measure for generosity because the percentage of salary replaced might be

very low but over a longer period of time so that the monetary value of the maternity pay scheme is not automatically correlated with this measure. Second, we calculated an often-used measure that allows an easier comparison across benefits, the so called full weeks' equivalent which estimates the full monetary value of the paid maternity benefits.[23] Table 2 provides the descriptive statistics for these different measures.

	N	Mean	SD	Minimum	Maximum
Weeks with full salary replacement	214	9.7	6.5	0.0	26
Full weeks' equivalent	210	18.4	3.9	7.1	39
Weeks of salary replacement	214	18.7	6.9	0.0	52

Table 2: Descriptive Statistics for Generosity Measures

We use all three measures as dependent variables in the subsequent analyses. Weeks of full salary replacement and full weeks' equivalent clearly measure the overall generosity of a maternity package and are highly correlated (0.84). The number of weeks for which some salary replacement is granted seems to be a less precise measure of generosity since a package could offer many weeks with very low pay or only a few weeks with full salary replacement. This variable thus co-varies to a lesser extent with weeks of full salary replacement (0.3) and full weeks' equivalent (0.5).

To operationalize the main explanatory factors for the generosity of maternity benefits derived from out theoretical discussion we include a number of variables that proxy costs and benefits, bargaining power of female academics, and research intensity. We also include several control variables, especially other university characteristics that should account for some variation in the generosity of occupational maternity packages. Most of these variables are available yearly and for each HEI from the Higher Education Statistical Agency (HESA). From HESA we obtain institutional data on the share of female full professors, the share of female academics at child bearing age (defined as below 40 years old), the ratio of female academic to administrative staff, and the student-to-staff ratio. As proxy for research intensity of a university we employ the 2008 overall RAE score also provided by HESA[24]. We measure the universities' budget as total yearly income (in millions of GBP). Finally, we operationalize the bargaining power of unions with union density data obtained from the UCU for several years (2007, 2013, 2015, and 2018)[25].

As additional control variables we use the total number of staff which can be regarded as a measure for institutional size, staff costs as share of university income as an alternative cost measure and a proxy for the university's budget constraint, and the income generated from research grants (in million GBP) as an alternative measure for research intensity[26].

As a kind of placebo test, we use the share of male professors, the overall share of female staff, the share of female senior managers, and the share of female administrative staff at child bearing age (under 40)[27]. Given our bargaining argument, these groups should be either unable to affect maternity provisions, or alternatively the university management has no incentives to provide these groups with their preferred maternity option.

Finally, we use membership in university groups, such as the Russell Group or the post '92 new universities, to control for potential peer-group effects and tackle potential spatial correlation across maternity packages[28]. To avoid potential endogeneity, particularly reverse causality issues, we measure the variables that affect decisions on generosity (but are potentially also determined by maternity generosity) in the year before each university implemented changes in maternity schemes. For example, if the maternity policies were changed in 2008, we look at these variables in 2007. For robustness, we also look at these variables uniformly in 2006, 2005, and 2004 - before the last major change in statutory provisions in 2007 (table C2 in appendix C). In fact, most HEIs majorly adjusted their occupational maternity packages between 2008 and 2013 after the last round of modifications in the UK statutory provisions was implemented on 1st April 2007 when the flat rate payment period was extended from 20 to 33 weeks[29]. We therefore measure university characteristics that should affect maternity provisions but not vice versa co-temporarily in 2013. Table 3 depicts some descriptive measures for these variables:

Right-hand-side variables – measured in the year before last changes in OMP	**N**	**Mean**	**SD**	**Minimum**	**Maximum**
Total number of staff	212	2749.67	2537.78	105	12600
Share of female staff	212	0.55	0.05	0.38	0.71
Ratio of female academic/admin staff	212	0.72	0.42	0.05	4.36
Share of female full professors	212	0.01	0.01	0.00	0.04
Share of female academics under 40	212	0.09	0.04	0.00	0.26
Staff costs per income (2013)	209	52.64	6.66	2.22	69.10
Income research grants in mill. £ (2013)	213	37.79	75.93	0.00	428.80
Total income in mill £ (2013)	209	208.27	222.14	6.68	1438.24
Student to staff ratio	212	16.27	4.64	1.40	31.20
RAE Score 2008	213	110.60	36.62	0.00	318.03
Share of male full professors	212	0.03	0.02	0.00	0.08
Share of female senior managers	212	0.00	0.01	0.00	0.04
Share of female admin staff under 40	212	0.15	0.04	0.04	0.47
UCU membership density	193	0.34	0.13	0.00	0.69

Table 3: Descriptive Statistics for Other Right-Hand-Side Variables

4.3 Empirical Specification: Accounting for Differences in Generosity

We test the 7 Hypotheses derived above with data on generosity of maternity provisions collected for 160 UK HEIs. Our main measure of generosity is the number weeks with full salary replacement granted by the most recent occupational maternity package. Since this is a count variable, a Poisson or Negative binomial model potentially represent adequate estimation choices[30]. However, weeks of full salary replacement are not typically Poisson distributed, which would imply many observations for smaller values decreasing with higher values, e.g. fewer universities grant 16 or 18 weeks of full salary replacement. We therefore estimate also a Negative binomial model and test whether there is significant over-dispersion (this seems to be the case[31]).

In addition, we expect that there is some interdependence across institutional maternity packages especially within peer-groups. This implies that dispersion of generosity is not equal across university groups but is rather smaller within more homogeneous affiliations with clear research goals (e.g. Russell Group and Golden Triangle[32]. We thus also employ a generalized negative binomial model which allows dispersion to be both different across groups and directly estimated[33]. We employ robust standard errors across all specifications to allow arbitrary heteroscedasticity across all observations[34].

Our empirical investigation is based on purely observational data, which makes it hard to draw any causal conclusions from the findings. Our empirical strategy therefore combines careful model specification with sanity checks for potential endogeneity issues, for example we measure the relevant explanatory factors in the year before a new maternity policy was decides upon and implemented. This strategy follow the idea of a difference-in-difference specification. We also employ a large number of robustness checks to give our derived hypotheses the hardest possible test. Still, empirical results have to be interpreted carefully with regards to causal claims.

We first present a set of baseline results for the main hypotheses. We subsequently look at whether these findings remain robust to a number of modification of the research design, such as alternative measures of maternity generosity, placebo tests and the evaluation of right-hand-side variables for different years prior to changes in occupational maternity pay.

4.4 Baseline Results: What affects the Generosity of Maternity Pay?

In this section, we present different specifications for a direct test of the main hypotheses derived from our theoretical discussion. Table 4 presents these baseline estimation results. Models 1, 4 and 5 display our preferred Negative binomial specification (which

is more appropriate given that the variance is significantly over-dispersed (model 1 – α, χ^2). Models 2 and 3 show that the results remain strongly robust when using other (less appropriate) estimators such as simple OLS (model 3) and Poisson (model 3) that – in our case – wrongly assumes equi-dispersion (mean=variance). Model 4 directly allows dispersion to be heterogeneous across different peer university groups, and model 5 adds union density to the list of explanatory variables[35].

The empirical results lend ample support to several of our derived hypotheses[36]. In terms of bargaining power, we find - as predicted, a previously large share of female professors affects the generosity of maternity benefits, positively (H1). This points to the observation that if women are in decision making positions, family policies become more salient and support for female academics increases. However, it doesn't seem to be the case that a stronger union representation increases the generosity of maternity benefits (H2, model 5). Union density seems to exert no significant effect on the generosity of institutionally provided maternity benefits. We check the robustness of this finding in appendix F by including each year available for UCU density into the right-hand-side of the estimation. The results are interesting. If anything union density affects the generosity of maternity benefits negatively (if we use density measures from 2007 and 2013 these effects are significant). We only can speculate about this result. One explanation might be that unions do not bargain over this specific issue, namely maternity policy. Unions seek to represent all employees, many of them being males and not necessarily concerned about maternity policies. Unfortunately, it was impossible to get a gender breakdown of union density by institution. It would be conceivable that as union density increases, more men become members (this is clearly just a conjecture) and that maternity benefits become less salient overall in terms of union priorities.

Turning to institutional incentives, with respect to retention our results show that indeed the previous share of female academics at child bearing age (under 40 years) increases the generosity of maternity pay (H7). [37] Two interpretations seem likely: first, there might be a lobbying effect due to the increase in bargaining power of female academics, and second, university managers might be aware that they could lose a large share of their academic staff if there are many women at child bearing age employed. We also find strong support for the hypothesis that more research-intensive universities (in terms of REF score) have stronger incentives to keep productive academics and thus reward them with more generous maternity benefits (H6). More generous benefits should allow female academics to stay in touch with research due to the prolonged and more generous maternity pay, without the continuous burden of carrying out teaching and administrative duties.

DV: Weeks of Full Salary Replacement	1 Negbin	2 Poisson	3 OLS	4 G_Negbin	5 Negbin
Total staff in 1000s (BC OMP)	0.081*	0.076*	0.872*	0.045	0.103**
	(0.048)	(0.041)	(0.485)	(0.032)	(0.041)
Acad. to adm. fem ratio (BC OMP)	-0.456***	-0.458***	-2.832***	-0.511***	-0.589***
	(0.162)	(0.166)	(0.801)	(0.157)	(0.154)
Share of female profs (BC OMP)	28.687***	24.373***	282.903***	23.337***	26.802***
	(7.410)	(6.575)	(65.638)	(6.029)	(9.391)
Female academics < 40 (BC OMP)	3.841***	3.864***	24.652**	4.164***	7.183***
	(1.405)	(1.345)	(10.535)	(1.342)	(1.791)
Staff costs/income ratio (2013)	-0.004	-0.003	-0.068	-0.004	0.000
	(0.009)	(0.009)	(0.067)	(0.011)	(0.013)
Research grant inc., mill. £ (2013)	-0.002*	-0.001	-0.001	0.000	-0.003*
	(0.001)	(0.001)	(0.011)	(0.001)	(0.001)
Total income in mill. £ (2013)	0.000	0.000	-0.003	-0.000	-0.000
	(0.001)	(0.000)	(0.006)	(0.000)	(0.001)
Student to staff ratio (BC OMP)	-0.022*	-0.018	-0.153	-0.009	-0.000
	(0.012)	(0.013)	(0.093)	(0.013)	(0.016)
RAE score (2008)	0.005***	0.003**	0.035***	0.004***	0.004*
	(0.002)	(0.001)	(0.013)	(0.001)	(0.002)
Different packages	-0.449***	-0.456***	-4.851***	-0.425***	-0.473***
	(0.074)	(0.071)	(0.641)	(0.067)	(0.075)
Scotland	0.363***	0.295***	3.120***		0.261**
	(0.109)	(0.103)	(1.135)		(0.112)
Northern Ireland	0.381**	0.361**	4.584**		0.390**
	(0.173)	(0.157)	(2.015)		(0.162)
Wales	-0.025	-0.092	-0.577		-0.281***
	(0.219)	(0.156)	(1.614)		(0.105)
Post 1992, not polytechnics				-0.528***	
				(0.145)	
Share of female ataff (BC OMP)					-2.361**
					(1.005)
UCU membership density (BC OMP)					-0.359
					(0.320)
Intercept	2.260***	2.426***	12.835***	2.399***	3.005***
	(0.479)	(0.506)	(3.978)	(0.605)	(0.827)
Dispersion (ln_alpha)					
Russell Group				-2.182**	
				(0.979)	
Golden Triangle				-10.823***	
				(0.201)	
Intercept	-1.690***			-1.407***	-1.944***
	(0.205)			(0.201)	(0.260)
N	208	208	208	208	188
R^2 (Pseudo)	0.082	0.218	0.442	0.102	0.098
Chi^2 / F	167.674	184.849	16.590	237.212	287.351
P_value (Chi^2 / F)	0.000	0.000	0.000	0.000	0.000
Alpha	0.185				0.143
Chi^2 (alpha)	132.620				

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01, BC OMP = year before the last Change in Occupational Maternity Package

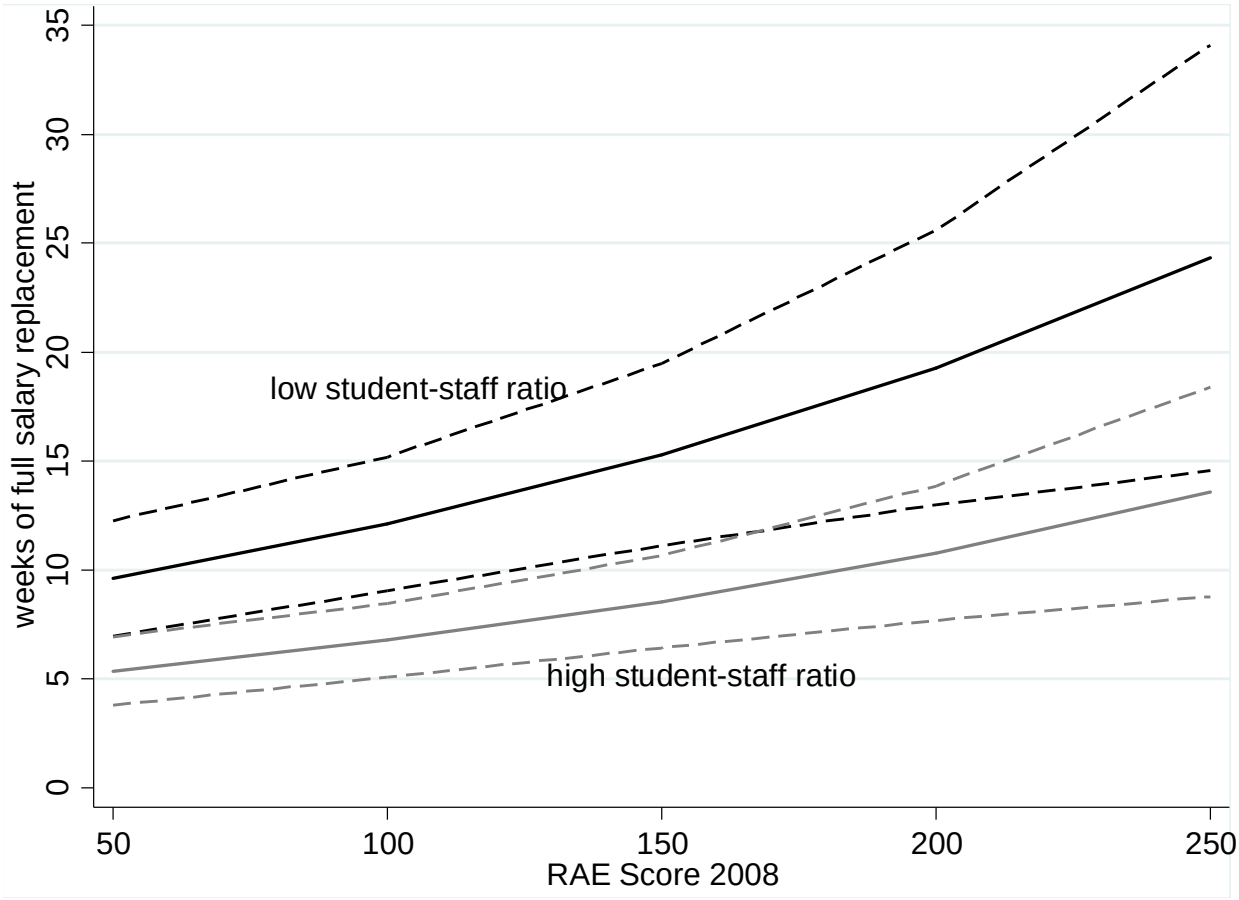
Table 4: Explaining the Generosity of Maternity Provisions across UK HEIs

Finally, regarding the cost of generous maternity pay, we find, in line with our theoretical expectations, that the question whether the student-to-staff ratios affect the generosity of maternity pay (H5) positively. All coefficients point in the right direction and are marginally significant. This supports the argument that when academic staff members have to teach and advise more students, replacement is harder and thus fewer weeks of full salary replacement are offered. Our estimation results also show that the ratio of female academics to female administrators, *tout court*, affects the generosity of maternity provisions negatively, because it increases overall costs associated with replacing higher salaries of academic staff (H4). Yet the financial resources available to an institution (measured as total income) do not affect occupational maternity pay (H3)[38]. This runs against the general belief that richer universities provide better maternity leave policies. We unpack the income effect in appendix D: total income is potentially multi-collinear with other university characteristics such as research income, research intensity, size in terms of staff, and staff cost as share of income. When we run models including each of the highly correlated indicators separately we find a small positive, marginally significant effect of institutional income on generosity lending some support to hypothesis 3 (model 3 in table D2).

The generalized negative binomial specification (model 4) tests, to some extent, the peer group effects on maternity generosity. We find two results that are consistent with our expectations. First, the dispersion of the generosity of benefits is significantly smaller for Russell Group members as well as for universities that belong to the Golden Triangle. These universities are leading institutions, in terms of research intensity, and therefore offer more generous maternity pay. They are also relatively more homogeneous in their goals and thus provide very similar packages with relatively high generosity levels.[39] Second, we find that new universities, which were founded after 1992 and had not been previously polytechnics, grant less generous maternity pay but their packages still vary across group members. This is likely to depend on the heterogeneous nature of this association that includes all post-1992 non-polytechnics. In addition, these newly founded universities are mostly teaching institutions that grant professional certificates rather than research degrees such as PhDs.[40]

To sum up, our results lend considerable support to most of our hypotheses but, in order to understand whether these effects are substantial we need to investigate their magnitude and size. We use the estimates of the Negative Binomial model (table 4, model 1) to assess the economic relevance of these effects. Figure 1 displays the combined effect of universities' research intensity (x-axis) and the student to staff ratio (small – black, large – grey)[41]. We can see that research intense universities with a small student to staff ratio

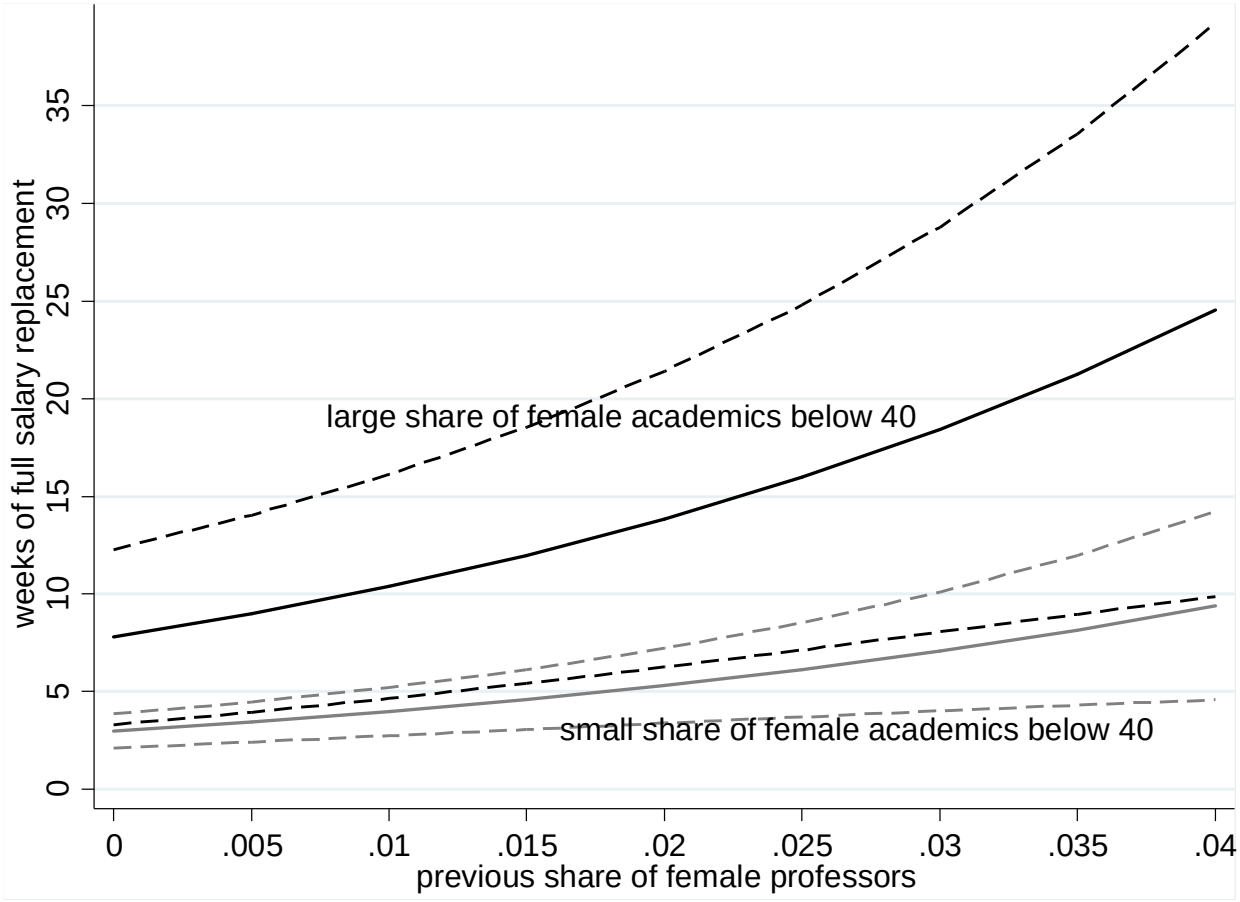
are 5 times as generous in their maternity provisions as compared to teaching oriented HEIs with a large student-to-staff ratio. Also, the positive effect of research strength is considerably stronger in institutions with a more favourable student-to-staff ratio. While teaching institutions with a high student-to-staff ratio offer provisions close to the observed minimal generosity (5 weeks of full salary replacement), the most research intense universities with a small student-to-staff ratio are predicted to offer benefits close to the observed maximum – 25 weeks of full salary replacement[42].



student-staff ratio: low=2, high=28

Figure 1: Predicted Weeks of Full Salary Replacement dependent on Student-Staff Ratio and Research Intensity

Similar combined effects can be observed for the previous share of female professors and the share of academic women at child bearing age (figure 2). Again, the predicted number of weeks with full salary replacement is more than 5 times larger in institutions with a large share of both female professors and female academics at child bearing age. Indeed, when the share of female professors is minimal the predicted generosity only varies between 3 and 8 weeks of full salary replacement.



share below 40: small=0, large=0.25

Figure 2: Predicted Weeks of Full Salary Replacement dependent on Previous Share of Female Professors and Female Academics at Childbearing Age

Based on the factors we are taking into account to explain institutional generosity of maternity pay, we compare our predictions to the actually observed number of weeks with full salary replacement and discuss some interesting discrepancies. For example, given its research intensity, student-to-staff ratio, share of female professors and female academics at child bearing age, income etc., the University of Nottingham is predicted to offer 18 weeks of full pay but only offers 8 weeks – a stark discrepancy. Similarly, our model over-estimates the expected generosity of the LSE (21 weeks predicted, vs. 18 weeks offered), Warwick university (20 vs. 16), Liverpool (12 vs. 8), Glasgow (25 vs. 16) and UCL (23 vs. 18). Contrarily, some universities are more generous than expected. For example, Southampton is predicted offer 18 weeks of full pay given its characteristics but grants 26 weeks of full salary replacement. We find similar results for the London Business School (14 predicted, 18 offered), and Oxford (22 predicted, 26 offered). These findings do not suggest any normative conclusions but show empirically that these institutions either over-provide or under-provide maternity benefits given their measurable characteristics. For a large number of universities, our simple baseline model makes exact predictions: Cambridge (18), Aberdeen (18), Lancaster (18), Leeds (16), Strathclyde (16), Northampton (6), Winchester (6), Cumbria (6), and the London University of Arts (4), *inter alia*.

4.5 Alternative Generosity Measures

We use alternative measures of generosity (full weeks' equivalent and weeks of full and partial salary replacement) as robustness checks. Table 5 presents the estimation results.

First, if we look at full weeks' equivalent – which is very closely related to weeks with full salary replacement – our results remain stable, both in size and significance which lends more robust support to our claims[43]. Second, the results differ in interesting but predictable ways for the other measure – number of weeks with full or partial salary replacement. This measure is often used in cross-country analysis because it is usually easier to collect it, but it does not really capture generosity since it gives higher values to schemes that grant very limited amounts of money for a large number of weeks (like the statutory pay in the UK which only offers 140.98 GBP but for 33 weeks). In this case, only two variables significantly affect the outcome: the student-to-staff ratio and union density. The student-to-staff ratio is a pure cost indicator underlining our argument that generosity is important for research oriented universities, which have an incentive to retain female academics and allow them to climb the career ladder to full professorship. Union density exerts a positive significant effect on the number of weeks with some salary

	Weeks of salary replacement: full time equivalent		Weeks of salary replacement (full and partial)	
Total staff in 1000s (BC OMP)	0.016	0.024*	0.007	0.025
	(0.015)	(0.014)	(0.027)	(0.026)
Acad to admin fem ratio (BC OMP)	-0.130***	-0.143**	-0.204**	-0.009
	(0.041)	(0.057)	(0.097)	(0.102)
Share of female profs (BC OMP)	6.595***	6.130*	5.754	1.002
	(2.149)	(3.160)	(3.937)	(6.250)
Female academics < 40 (BC OMP)	1.018**	1.627**	1.156	1.317
	(0.419)	(0.665)	(1.132)	(1.516)
Staff costs to income ratio (2013)	0.001	-0.000	0.010	0.003
	(0.002)	(0.004)	(0.008)	(0.007)
Income research grants, mill. £ (2013)	-0.001	-0.001	-0.001	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
Total income in mill. £ (2013)	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Student to staff ratio (BC OMP)	-0.010***	-0.006	-0.020**	-0.028***
	(0.004)	(0.005)	(0.008)	(0.009)
RAE score (2008)	0.001	0.001	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Different packages	-0.103***	-0.111***	0.043	0.009
	(0.028)	(0.030)	(0.061)	(0.066)
Scotland	0.095***	0.071*	0.062	0.159*
	(0.031)	(0.037)	(0.082)	(0.090)
Northern Ireland	0.055	0.079	-0.151	-0.163
	(0.042)	(0.049)	(0.195)	(0.154)
Wales	0.069	0.002	-0.004	0.044
	(0.074)	(0.039)	(0.146)	(0.168)
UCU membership density (BC OMP)		-0.094		0.500**
		(0.104)		(0.241)
Intercept	2.921***	2.920***	2.543***	2.672***
	(0.131)	(0.241)	(0.384)	(0.399)
N	208	188	208	188
R^2 (OLS)	0.348	0.370	0.141	0.150
R^2 (Pseudo)	0.051	0.053	0.020	0.022
Chi^2	109.618	134.602	32.001	30.496
P_value (Chi^2)	0.000	0.000	0.002	0.007
Alpha	0.000	0.000	0.094	0.087

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01, BC OMP = year before the last Change in Occupational Maternity Package, All Models Negative Binomial

Table 5: Alternative Measures of Maternity Benefit Generosity

replacement. From this finding we might speculate that unions are more interested in length than generosity of maternity leave. In addition, the overall explanatory power (R^2) halves for these models lending further support to the conclusion that other factors predict maternity provisions that are not related to generosity.

4.6 Placebo Tests: Administrators and Male Academics

As robustness test, we first run the same specification as in table 4 (model 1) but we add some additional variables to the right-hand-side in order to check the consistency of our findings and to understand whether factors, which based on our theoretical discussion should have no effect, indeed turn out to be statistically insignificant. We call this a placebo test. Specifically, we want to test whether the share of senior male academics (full professors) influences the generosity of maternity packages. We find this variable has no effect, which is in line with our expectation. We also argue that female academics (full professors and those at child bearing age) hold the main bargaining power because of the skill specificity of their jobs and the universities' investment in their recruitment and productivity. We therefore expect that the presence of a large share of senior female managers or female administrators at child bearing age should have no effect on the generosity of maternity provisions, and we find ample support for this prediction. All other results correspond closely in direction, significance, and size to our baseline findings. Estimation results can be found in table 6.[44]

DV: Weeks of Full Salary Replacement	1 Negbin	2 Negbin	3 Negbin
Total staff in 1000s (BC OMP)	0.089*	0.090*	0.088*
	(0.047)	(0.047)	(0.045)
Acdemic to admin females ratio (BC OMP)	-0.370**	-0.380*	-0.307
	(0.187)	(0.194)	(0.236)
Share of female profs (BC OMP)	21.183**	21.208**	19.253*
	(10.015)	(9.940)	(10.207)
Female academics under 40 (BC OMP)	3.125*	3.273*	3.267*
	(1.624)	(1.778)	(1.785)
Staff costs to income ratio (2013)	-0.006	-0.006	-0.005
	(0.009)	(0.009)	(0.009)
Income research grants in mill. £ (2013)	-0.002*	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)
Total income in mill. £ (2013)	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
Student to staff ratio (BC OMP)	-0.019	-0.018	-0.016
	(0.012)	(0.013)	(0.013)
RAE score (2008)	0.004**	0.004**	0.004**
	(0.002)	(0.002)	(0.002)
Different packages	-0.447***	-0.446***	-0.445***
	(0.077)	(0.077)	(0.077)
Share of male professors (BC OMP)	5.536	5.644	6.462
	(4.375)	(4.318)	(4.555)
Share of senior female managers (BC OMP)		3.650	3.021
		(9.455)	(9.400)
Female administrators under 40 (BC OMP)			0.885
			(0.979)
Scotland	0.341***	0.339***	0.353***
	(0.113)	(0.114)	(0.116)
Northern Ireland	0.382**	0.388**	0.401**
	(0.164)	(0.163)	(0.166)
Wales	-0.076	-0.069	-0.075
	(0.222)	(0.224)	(0.223)
Intercept	2.293***	2.266***	1.999***
	(0.498)	(0.503)	(0.580)
N	208	208	208
R^2 (ols)	0.450	0.452	0.454
R^2 (Pseudo)	0.084	0.084	0.084
Chi^2	212.116	216.790	223.769
P_value (Chi^2)	0.000	0.000	0.000
Alpha	0.179	0.179	0.177

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01, BC OMP = year before the last Change in Occupational Maternity Package

Table 6: Placebo Tests – Effect of Male Professors and Female Administrators

5 Discussion: What Factors Determine the Generosity of Occupational Maternity Pay?

UK higher education institutions vary greatly in the generosity of the occupational maternity pay they grant to their employees. We find that much of this variation can be explained with a bargaining model in mind that distinguishes between the factors that increase the bargaining power of female academics, the incentives for universities to invest in the retention of female talents, and the costs imposed by generous maternity provisions. Differences in the structural characteristics of these institutions contribute to these different incentives. The sheer size, in terms of employees, but also structural factors, such as the student-to-staff ratio, help to account for differences in generosity because these features describe how the potential costs of women taking maternity leave can be redistributed across other staff members. Interestingly, size, in terms of overall income, does not help much to explain the variance in generosity of maternity benefits. Thus, it seems that decisions on maternity benefits are closely related to the strategic goals universities pursue. One of the driving factors behind the design of maternity pay is the research orientation of the university under investigation. Highly research intense institutions have a vested interest in retaining productive mothers both at the hiring stage as well as during their employment at the university. Better maternity provisions are very likely to be used in these cases as a reward and a means to keep mothers productive and satisfied with their work environment, thus allowing them to invest in research activities. More generally, it seems that the rigorous hiring process across research intense universities serves as a screening device.

The bargaining power of female academics (who can affect the process of deciding over maternity benefits) is mainly strengthened by both the share of female professors in place when decisions are made and the share of female academics at child bearing age. Female professors can be compared to women in executive positions in other sectors and can influence policy outcomes at universities; the number of female academics at child bearing age increases the probability that the university loses many talented and productive women if maternity provisions are sparse. We also argue – and empirically confirm – that the same logic is not at stake for female administrators, arguably because they can be replaced more easily, their share is generally large, and the university's investment in administrative staff is comparatively lower. Neither the share of female senior managers nor female administrators at child bearing age, have an effect on maternity provisions.

Certainly these results have to be taken with some caution given the observational nature of the analysis. However, all specifications and not withstanding any robustness

checks, alternative measures, and placebo tests, point in the same direction and effect sizes remain stable as well. We are therefore cautiously confident that the correspondence between theoretical derivation of hypotheses and the empirical investigation of these allow us to draw some conclusions on how HEIs decide on maternity and parental leave benefits.

6 Conclusion

Maternity and parental policies are costly and their costs and benefits are widely debated beyond the normative aspect of allowing women to have children without sacrificing their professional careers. Understanding how and why institutions decide to implement certain levels of generosity in maternity pay may help to unpack the potential costs and benefits of maternity leaves. This work uses a bargaining model to account for the variation in maternity policies across Higher Education Institutions in the UK. The model and our empirical analysis show that both structural characteristics but also strategic goals of universities help explaining the generosity of maternity pay across UK universities. Research-intensive universities have much stronger incentives to implement generous maternity pay provisions – from which follows that the potential benefits of maternity provisions might be stronger for such institutions.

Research shows that maternity and parental policies are crucial to keep women talents in the labour market, reduce the pay gap and allow women to climb the career ladder (Ginther and Kahn 2004; Ginther and Hayes 2003; Waldfogel 1998; Mason and Goulden 2004; 2002). Our work highlights the institutional-based constraints and incentives offered to women in the UK academic sector and represents a first step in unpacking the causes and consequences of generous maternity benefits. In a companion research paper, we investigate how differences in maternity benefits affect productivity, career paths, pay, and job satisfaction of female academics. We show that the generosity of maternity leaves exerts significant effects on career paths of female academics at the aggregate level, with more generous provisions likely to lead to a higher share of female professors and female academics in the highest salary bracket, especially at research intense universities. At the individual level, we can identify a positive effect of generosity on productivity, speed of career progression, and income in the medium term.

From our perspective, the UK higher education sector provides fertile ground for such investigations because maternity benefits vary widely across universities and the productivity and career paths can be measured straightforwardly at the individual level. We believe that the implications of our research extend beyond higher education institutions

and offer further insights on the determinants of the under-representation of women in qualified and competitive sectors. Moreover, given that the generosity of statutory maternity pay in the UK is one of the lowest across EU countries, our research can help inform policy reforms in this area. Of course, we do not claim that our results allow extending our conclusions to other sectors. Rather, the identification revolution in social sciences is increasingly pressuring scholars to identify local causal effects that are highly conditional on the context and inferences beyond this specific context are usually hard to draw. Yet, our theoretical argument regarding how these policies are implemented, clearly draws on broader bargaining theories that do not apply to the university sector only. Though with caution, our results can help interpreting the variation in maternity policies in other sectors.

Notes

[1]Yet with notable exceptions: The USA is the only OECD country lacking of federal policies on maternity benefits of leave for workers. Globally, only other two countries, Papua New Guinea and Suriname provide no paid maternity leaves (See, *inter alia*, Raabe and Theall (2016).

[2]We focus on the generosity of occupational maternity pay because the length does not vary and is determined by the statutory provision that a job has to be held for 52 weeks after childbirth.

[3]Most occupational maternity packages (namely, 127 packages in our sample) require continuous employment for at least 52 weeks at 15 weeks prior to expected childbirth. This is longer than the typical fixed term contract that lasts 12 months or just an academic year.

[4]On average across OECD countries, mothers are entitled to 52 weeks of leave but there is a stark variation across countries and sectors. See `https://www.oecd.org/els/soc/PF2_1_Parental_leave_systems.pdf`

[5]This is usually ascribed to skill atrophy and human capital depreciation resulting from long leaves or to signalling, where the leave taking behaviour is used by the employer as a signal of the employee's type and her future career commitments (See, *inter alia*, Albrecht et al. 1998).

[6]The ILO convention on maternity leave and the current EU directive on maternity leave stipulate that mothers should have access to at least 14 weeks of leave around childbirth. On average, OECD countries provide for 18 weeks of paid maternity leave around childbirth but, again, there is a large cross-country and within-country variation in payment rates. Replacement incomes are lowest in Ireland and the United Kingdom, where full-rate equivalent paid maternity leave lasts only nine and twelve weeks respectively. See `https://www.oecd.org/els/soc/PF2_1_Parental_leave_systems.pdf`.

[7] The effects of maternity leave have been examined in relation to women productivity and attachment to the labour market and a number of other related aspects such as intra-household time allocation, mothers' psychological and physical well-being and children's human capital (inter alia, Gornick and Meyers 2003; Belbo, Bendery and Wolf 2009; Bernal and Fruttero 2008; Pylkkänen and Smith 2003; Wetzels and Tijdens 2002; Waldfogel et al. 1999; Ruhm 1998; Ondrich et al. 1996; Winegarden and Bracy 1995; Stoiber 1990). The analysis of the effects of maternity leave provisions goes beyond the scope of this paper, which focuses on the supply side of maternity schemes and the likely determinants of maternity leave policies across Higher Education Institutions in the UK.

[8]For example, in the USA, finance, insurance and real estate sectors grant more generous policies than retail, construction and wholesale industries. Favourable arrangements are also prevalent in public sector jobs (Evans 2001). This is usually attributed to the relative bargaining power of public sector employees, who are very likely to belong to trade unions or professional organizations. Large firms (with more that 1000 employees) grant more generous policies than small and medium enterprises. This is commonly regarded as an effect of economies of scale, where the fixed cost of family-friendly provisions can be spread over a larger level of output (Comfort et al. 2003). Less is known about small and medium enterprises because of data limitation and inconsistencies in the definition of this category across countries. SMEs are less likely to have formal or stated work-life balance policies and the extent of these provisions is less likely to be captured by surveys. In addition, the definition of SMEs varies across countries (from 250-500 employees in the UK to 5-25 employees in New Zealand) and this prevents a systematic comparison of SMEs' policies across countries.

[9]The concept of capabilities focuses on individuals' "functionings", namely their effective freedom to choose what they want to be and do. First articulated by Amartya Sen in the 1980s in contrast to utilitarian

approaches to human development, the capability approach has been expanded by Martha Nussbaum (2000), who derived a list of central capabilities to be embedded in national constitutions and guaranteed to all up to a certain threshold. The notion of capabilities and functionings are central to the evaluation of welfare policies in the context of gender equality (see, *inter alia*, Hobson, Duvander and Halldén 2007 in *Children, family policies and welfare state changes*, ed. J. Lewis. Cheltenham, UK: Edward Elgar).

[10]There exists a large literature on the policy developments on maternity and parental leaves, childcare provisions and working time arrangements in the UK vis a vis other Western European countries, to which our paper cannot do justice here. For an encompassing review, see Lewis (2009).

[11]Since statutory maternity benefit entitlements are comparatively low in the UK compared to other OECD countries, most employers across most sectors top up legal provisions with contractual or occupational provisions. These OMPs vary greatly across and within sectors, whereby engineering, civil service institutions and manufacturing provide on average more generous maternity pay than for example the finance sector, the non-for profit sector, or the food and drink industry. But the provisions also vary greatly regarding generosity as well as eligibility within sectors depending on firm size and other factors. Merck Pharmaceuticals for example pay 39 weeks of full salary with no eligibility period but requires 2 years of service after receiving these benefits. Citroen UK grants 40 weeks at 90 percent pay and Philips Electronics UK as well as AOL Europe 6 months full salary replacement, topped by the BMW plant (Hams Hall) granting 10 months of full pay after 1 year of service. On the other hand, Domino's Pizza and the Pensions Trust only offer 6 weeks at full pay and many county councils only 90 percent salary replacement for the first 6 weeks. A representative account of maternity provisions across sectors can be found here:`https://www.xperthr.co.uk/editors-choice/examples-of-occupational-maternity-pay-schemes/79170/`

[12]The Athena SWAN charter (Scientific Women's Academic Network) was established in 2005 and is managed by the British Equality Challenge Unit with the aim of promoting and supporting diversity and equality in higher education institutions in the UK.

[13]Since bargaining processes are not completely formalized and can remain rather implicit we talked to several Human Resources Directors across UK HEIs to understand how university management implements changes in occupational parental leave policies. We thank in particular, the Director of Human Resources at Warwick University, Gillian McGrattan for her valuable insights.

[14]Both sets of predictions are consistent with an asymmetric Nash-bargaining protocol among others.

[15]GEW, UCU, and SULF (2011): Quality in Academia and Life: a joint strategy to improve Work-Life Balance.

[16]Formerly, RAE – Research Assessment Exercise. The RAE was replaced by the Research Excellence in 2014. See: `https://www.ref.ac.uk/about/what-is-the-ref/`

[17]The REF is undertaken periodically about every 5 to 7 years by HEFCE - The Higher Education Funding Council for England (now UK Research and Innovation) and evaluates academic departments based on their research output, the research environment, and the non-academic impact of the research produced in the department. For each discipline a panel of experts evaluates outputs, environment and impact and a final score that combines these aspects will be generated and published. Based on this score departments can be ranked and government funds are distributed according to the ranking.

[18]Again, this also supports our previous argument that generosity of maternity pay *does* depend on female academics more than on female administrators.

[19]See OECD Family Database `http//www.oecd.org/social/family/database.htm` for a summary of maternity and parental leave provision by country.

[20]Unfortunately, we do not have enough variation across eligibility criteria to statistically explore eligibility as a potential screening mechanism but it is usually the case the more generous maternity pay requires a longer employment to become eligible, e.g. 52 weeks vs. 104 weeks of continuous employment before the 15th week of expected childbirth.

[21] The data collected covers the most recent occupational maternity policies implemented by each UK higher education institution before the shared parental leave policy came into place in 2016. The data was collected in 2015 and represents the state of OMPs at that date. Data collection was carried out by Monica Giovaniello, a research assistant and PhD student at the Economics Department at the University of Warwick and verified and double-checked a team of Research Assistants. The documents containing maternity policies were downloaded from each universities website or if not available requested from their HR department. We coded for each OMP all specific aspects of maternity benefits, e.g. weeks with full salary replacement, weeks with partial salary replacement – the percentage of salary that is replaced, number of weeks with SMP, number of weeks paid at statutory flat rate, number of weeks without pay, eligibility criteria such as required length of service, provisions for adoption, paternity and additional parental leave. All documents and the raw data are available upon request from Vera Troeger, the PI of the project.

[22]See table B1 in Appendix B for a break-down of all packages by HEIs.

[23]This measure sums the weeks with full pay, plus all partial pay, plus weeks of statutory maternity pay. In the UK SMP grants 90 percent of the average weekly earnings (before tax) for the first 6 weeks and the lower of £140.98 or 90 percent of the average weekly earnings for the next 33 weeks. We measure average earnings as average female salary per institution which we calculate from the institutional data available from HESA (Higher Education Statistical Agency). This measure is very closely related to our preferred measure of just the number of weeks with full salary replacement.

[24]We also use the share of 4* submission but the results do not change and this variable is very highly correlated with the overall RAE score.

[25]We thank Matthew Waddup from the UCU for providing this data. Since we do not have yearly data and to avoid potential endogeneity we create a density measure that contains the density for each university in the year closest to but before the last change in maternity policies.

[26]These three measures are provided by Higher Education Statistical Agency (HESA).

[27]Obtained from HESA.

[28]We collected membership data ourselves from various websites. Appendix G gives an overview over these groups and their membership. Russell Group universities for example are public research universities with a strong focus on research, Russell Group members receive more than 3/4 of grant income, their graduates hole more than 60 percent of all UK jobs that require a university degree, and in the 2014 REF almost 70 percent of world-leading and high impact research was conducted in Russell Group universities. Post-1992 universities, also called new or modern universities, in comparison are former polytechnics or central institutions in the UK that were given university status through the Further and Higher Education Act 1992. Most of these HEIs are more teaching oriented and cannot grant PhD degrees.

[29]This was the last major change in statutory maternity pay, in 2009 additional provisions for fathers were implemented and in 2015 shared parental leave was introduced with no changes to the actual monetary value of the parental leave benefits. We will happily provide the raw data that also shows in which year the current OMP was implemented in each of the analysed HEIs.

[30]We use a (potentially misspecified) OLS model as benchmark, esp. given that the DV is not typically Poisson distributed.

[31]See the coefficient for α – the overdispersion parameter -, and its χ^2 value which indicates that alpha is significantly different from zero in model 1, table 4.

[32]The 'golden triangle' is an unofficial grouping of research universities located in Cambridge, Oxford, and London, e.g. Imperial College, University College, King's College London and the London School of Economics and Political Science.

[33]We derive formal representations for the employed estimators in appendix H.

[34]Given that we estimated different variances across subgroups of institutions there is no indication for additionally clustering standard errors. Moreover, the overall number of observations remains too small to allow for reasonable cluster size.

[35]We estimate a separate model for union density because this variable is not available for all universities and thus significantly reduces the number of usable observations.

[36]In terms of model fit, our relatively parsimonious specifications are doing quite well. The OLS R^2 indicates that almost 50 percent of the variation in maternity benefits can be explained by the included variables. The pseudo R^2 in negative binomial models is generally believed not to be a good measure of fit. However, the χ^2 values are large and highly significant indicating that the models presented add significant to the explanatory power as compared to the intercept-only model.

[37]Since this hypothesis does not follow directly from the formal model, we run all specifications without this variable on the right-hand-side, with no changes to the substantive effects of the other covariates. Results are part of the replication material.

[38]We look at total income, as well as net income but results remain insignificant.

[39]These results come from the specification of the dispersion equation in the generalized negative binomial model.

[40]We ran comparative models with different combinations of all other group memberships. We did not find any additional significant results and thus we are not reporting these findings here. However, the significant relationships we found are fully consistent with our argument. We investigate the peer group effect further in appendix E where we employ a spatial lag specification including spatial lags weighted by group membership. Out findings support the findings of the generalized negative binomial model in table 4. The spatial lag specification also addresses potential non-independence of observations of the dependent variable, i.e. maternity packages across institutions are not independent of each other. Since the effects of the main explanatory variables in the spatial lag specification remain robust both in size and statistical significance, we conclude that while the independence assumption might be violated, this does not affect our conclusions. We thank our anonymous reviewers for making this suggestion.

[41]Small = 2, large= 28

[42]All other explanatory variables are fixed at their sample means for predictions.

[43]Only the number of total staff turns out to be not significant any more.

[44]In appendix C, we run additional robustness checks for right-hand-side variables measured at different points in time and an outlier analysis, however our findings remain stable to the inclusion/exclusion of outliers.

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Appendix

A A Theoretical Model of Bargaining over Occupational Maternity Benefits

In this appendix, we present a parsimonious and stylized bargaining model between the university leadership and their female employees (or their representatives). The model is mostly meant to illustrate the main hypotheses described in the main body of text.

Consider a university with N employees and K students, defining a student-to-academic staff ratio η. The university employs N_f female employees, a proportion λ of which are academics (we omit integer issues for simplicity, but without loss of generality). We employ a Nash bargaining model between the leadership of the university (L) and the female employees (F) regarding the generosity of maternity leave provision m. The bargaining power of female employees is $\beta(f)$, which we assume is increasing in the proportion of women among professors f

The leadership tries to maximize the expected return on maternity leave provision. Better maternity leave provision (higher m) permits better retention of staff $p(m)$, increasing and strictly concave in m. The benefit of retaining staff depends on the research environment R. Higher R implies that academic staffs are more valuable to the university due to their research outputs (which increase the university reputation) and/or the cost of replacing such scholars (intense recruitment procedures with visits, job talks, etc.). Notice that, for simplicity, we assume that retaining administrative staff is also more valuable in a high research environment (high R) since stability can help scholars focus on their most important tasks: research and stability (anecdotal evidences and experience suggest that efficient administrative staffs are extremely valuable). Our results would still hold (under some conditions) if the benefit of retaining academic staff members is higher than the benefit of retaining administrative staff members.

On the cost side, we denote the marginal cost of maternity leave provision per female employee by $k_A(\eta)$ for academic and k_S for administrative support staff (the linearity assumption is for ease of exposition only). We assume that $k_A(\eta) > k_S$ given that academics tend to have higher salary than administrative staff. We also assume that $k_A(\eta)$ is strictly increasing with η, the student-to-academic staff ratio. Higher η makes it more difficult to reallocate students to academics (given the system of advisee/advisor or

mentee/mentors in the U.K.) or can force the university to hire replacement to academics in maternity leave.

Hence, the university leadership's payoff assumes the following form:

$$U_L(m) = N_f(Rp(m) - \lambda k_A(\eta)m - (1-\lambda)k_S m)$$

Turning to the female employees, they seek to maximize maternity leave provision. The (material and immaterial) benefit of m is denoted $u(m)$, increasing and strictly concave in m. The female employees' utility can thus be represented as

$$U_F(m) = N_f u(m)$$

The maternity leave decision faces two additional constraints. First, the cost cannot be higher than the university budget B. Hence, m must satisfy

$$N_f(k_A(\eta)m + (1-\lambda)k_S m) \leq B$$

Second, the maternity leave provision cannot be lower than the legal minimum which we denote $\underline{m}$ so $m \geq \underline{m}$.

Using the Nash bargaining framework, the maternity leave provision at the university is the solution to the following maximization problem

$$\max_m \Big(N_f(Rp(m) - \lambda k_A(\eta)m - (1-\lambda)k_S m)\Big)^{1-\beta(f)} \Big(N_f u(m)\Big)^{\beta(f)} \tag{A1}$$
$$\text{subject to } N_f(\lambda k_A(\eta) + (1-\lambda)k_S)m \leq B \text{ and } m \geq \underline{m}$$

Observe that our model is flexible enough to encompass both a bargaining and a cost-benefit analysis approach. Indeed, if the female employees have no say in the decision ($\beta(f) = 0$), then the problem reduces to simply maximizing the university leadership's expected payoff. The cost-analysis approach is thus a special case of our overall framework.

While the model can be solved in general terms, our goal here is to provide an illustration of our empirical hypothesis. To facilitate this, we impose some additional assumptions. First, we suppose that $p(m) = \frac{m^\tau}{\tau}$, with $\tau < 1$. Second, we assume that $u(m) = \frac{m^\gamma}{\gamma}$, with $\gamma < 1$. Since we interpret $p(m)$ as a probability, we also impose

$\frac{B}{N_f \lambda k_A(\eta)+(1-\lambda)k_S)} < \tau^{\frac{1}{\tau}}$ so that the probability of retention is always strictly less than 1 (this last assumption is meant to simplify the exposition).[45]

With these assumptions, we can state our main results. To do so it is helpful to define $\widehat{m}$ as the unique solution to

$$\frac{m^{\tau-1}}{\tau} = \frac{\lambda k_A(\eta) + (1-\lambda)k_S}{R} \frac{1-\beta(f)(1-\gamma)}{1-\beta(f)(\tau-\gamma)} \tag{A2}$$

Notice that obviously $\widehat{m}$ is a function of all parameter values in Equation A2. We come back to this when we consider comparative statics.

Our first proposition establishes the equilibrium level of maternity leave provision. Basically, $\widehat{m}$ is the solution to the (unconstrained) bargaining problem. However, as stated above, there are two constraints to satisfy. First, the maternity leave provision must be higher than the minimum legal. Second, it cannot be so high as to impose an undue financial burden on the university. The proposition establishes when this is the case.

Proposition 1. *The equilibrium level of maternity leave provision m^* satisfies*

$$m^* = \begin{cases} \underline{m} & \text{if } \widehat{m} \leq \underline{m} \\ \widehat{m} & \text{if } \underline{m} < \widehat{m} < \frac{B}{N_f(\lambda k_A(\eta)+(1-\lambda)k_S)} \\ \frac{B}{N_f(k_A(\eta)+k_S)} & \text{otherwise} \end{cases} \tag{A3}$$

Notice that an increase in the legal requirement or in the university's budget both weakly increase the maternity leave provision at the university. However, these two variables matter only if the bargaining outcome is such that the constraints become binding. If bargaining leaves financial room to the university, then the budget will have no impact on the maternity leave provision. Hence, the model provides one possible rationale for our null finding on this particular variable.

We now turn to the comparative statics regarding the bargaining solution. Assuming that the legal and financial constraints are not binding, then these comparative statics exactly correspond to our hypotheses. Conform with intuition, as the cost of maternity leave provision increases—due to higher student-to-academic staff ratio η, which raises $k_A(\cdot)$, or higher share of female academic staffs, since $k_A(\eta) > k_S$, maternity leave provision decreases. In turn, as the share of female professors (past or present) raise, so does the bargaining power of female employees ($\beta(f)$) which lead to better maternity leave provision (higher $\widehat{m}$). Indeed, female employees value maternity leave provision more

than the university leadership. Finally, the more the leadership cares about retention (R increases), the more they are willing to offer generous maternity leave provision so $\widehat{m}$ also rises. To summarize, we obtain:

Proposition 2. *Suppose* $\underline{m} < \widehat{m} < \frac{B}{N_f \lambda k_A(\eta) + (1-\lambda)k_S)}$. *The equilibrium level of maternity leave provision*

(i) increases with research intensity (R) and the share of female professors (f)

(ii) decreases with the share of female academics (λ) and the student-to-academic staff ratio (η)

Proofs

Denote $m^{max} \equiv \frac{B}{N_f(\lambda k_A(\eta)+(1-\lambda)k_S)}$. We add the assumption that $p(m^{max}) - (\lambda k_A(\eta) + (1-\lambda)k_S)m^{max} \geq 0$. We first establish the solution to the bargaining maximization problem (A1). Consider the function $V(m) = (1-\beta(f))\log\left((Rp(m) - \lambda k_A(\eta)m - (1-\lambda)k_S m) + \beta(f)\log(u(m))\right.$. Under the assumptions, $V''(m) < 0$ on the interval $[0, m^{max}]$ so the problem is well behaved on this interval. Omitting the upper constraint for ease of exposition, taking the first order condition we obtain:

$$(1-\beta(f))\frac{Rp'(m) - \lambda k_A(\eta) - (1-\lambda)k_S}{Rp(m) - \lambda k_A(\eta)m - (1-\lambda)k_S m} + \beta(f)\frac{u'(m)}{u(m)} = 0$$

Imposing the functional forms, we obtain

$$\begin{aligned}
& (1-\beta(f))\frac{Rm^{\tau-1} - \lambda k_A(\eta) - (1-\lambda)k_S}{R\frac{m^\tau}{\tau} - \lambda k_A(\eta)m - (1-\lambda)k_S m} + \beta(f)\frac{\gamma}{m} = 0 \\
\Leftrightarrow \quad & (1-\beta(f))(Rm^\tau - \lambda k_A(\eta)m - (1-\lambda)k_S m) + \beta(f)(R\frac{m^\tau}{\tau} - \lambda k_A(\eta)ma - (1-\lambda)k_S m) = 0 \\
\Leftrightarrow \quad & ((1-\beta(f))\tau + \beta(f)\lambda)\frac{m^\tau}{\tau} = (\lambda k_A(\eta) + (1-\lambda)k_S)m((1-\beta(f)) + \beta(f)\lambda) \\
\Leftrightarrow \quad & \frac{m^{\tau-1}}{\tau} = \frac{\lambda k_A(\eta) + (1-\lambda)k_S}{R}\frac{1-\beta(f)(1-\gamma)}{1-\beta(f)(\tau-\gamma)}
\end{aligned}$$

We thus obtain Equation A2 and define $\widehat{m}$ as the unique solution of this equation (to see existence and uniqueness, note that the left-hand side of Equation A2 is strictly decreasing with m since $\tau < 1$ and tends to ∞ as m tends to 0 and to 0 as m tends to infinity, slightly abusing the range of m).

Proof of Proposition 1

The result follows directly from the analysis above (which defines an unconstrained solution) and the existence of constraints. In particular, $\widehat{m} \leq \underline{m}$ and $\widehat{m} \geq \frac{B}{N_f(\lambda k_A(\eta)+(1-\lambda)k_S)}$ signifies that the legal and financial constraints, respectively, are not satisfied by the unconstrained solution. □

Proof of Proposition 2

As noted above, the left-hand side of Equation A2 is decreasing with m. Hence, an increase (resp. decrease) in the right-hand side of Equation A2 yields a decrease (resp. increase) $\widehat{m}$ (by the Implicit Function Theorem, though we could also work with closed form solution). It can be checked that $\frac{\lambda k_A(\eta)+(1-\lambda)k_S}{R}\frac{1-\beta(f)(1-\gamma)}{1-\beta(f)(\tau-\gamma)}$ is increasing with η (since $k_A(\eta)$ is increasing with η), increasing with λ (since $k_A(\eta) > k_S$), decreasing with R and f (since $\beta(f)$ is increasing with f and $\frac{1-\beta(f)(1-\gamma)}{1-\beta(f)(\tau-\gamma)}$ is decreasing with $\beta(f)$). □

B Generosity across HEIs

Table B1 Generosity of Occupational Maternity Pay across UK HEIs[46]

Weeks with full salary replacement	Number of packages	HEIS
0	15	Anglia Ruskin University, Conservatoire for Dance and Drama, Edge Hill University, Falmouth University, Guildhall School of Music and Drama, Leeds College of Music, Leeds Metropolitan University, Norwich University of the Arts, Queen Margaret University (Edinburgh), Ravensbourne, Royal Agricultural University, The University of Bolton
4	51	Bath Spa University, Bishop Grosseteste University, Buckinghamshire New University, Canterbury Christ Church University, Cardiff Metropolitan University, Central School of Speech and Drama, Coventry University, Falmouth University, Harper Adams University, Leeds Trinity University, Liverpool Hope University, Liverpool John Moores University, London Metropolitan University, London South Bank University, Rose, Bruford College, Royal Academy of Music, Royal College of Music, Royal Northern College of Music, St Mary's University College, St Mary's University College (Twickenham), Stranmillis University College, Teesside University, The Liverpool Institute for Performing Arts, The University of Chichester, The University of Huddersfield, The University of Lincoln, The University of Northumbria at Newcastle, The University of Plymouth, The University of Portsmouth, The University of Wales (Newport), The University of West London, The University of Wolverhampton, The University of Worcester, Trinity Laban Conservatoire of Music and Dance, University for the Creative Arts, University of Bedfordshire, University of Chester, University of Glamorgan, University of Gloucestershire, University of Hertfordshire, University of St Mark and St John, University of the Arts (London)
6	27	Anglia Ruskin University, Bournemouth University, De Montfort University, Falmouth University, Newman University, Roehampton University, Royal Conservatoire of Scotland, Southampton Solent University, Staffordshire University, Swansea Metropolitan University, The Arts University Bournemouth, The Arts University Bournemouth, The City University, The Manchester Metropolitan University, The Nottingham Trent University, The University of Bradford, The University of Brighton, The University of Northampton, The University of Westminster, The University of Winchester, University of Cumbria, University of Derby, University of the West of England (Bristol), Writtle College, York St John University
8	38	Aberystwyth University, Bangor University, Birmingham City University, Brunel University, Cranfield University, Goldsmiths College, Heriot-Watt University, Imperial College of Science Technology and Medicine, St George's Hospital Medical School, Swansea University, The Royal Veterinary College, The University of Bath, The University of Bristol, The University of Dundee, The University of East Anglia, The University of Edinburgh, The University of Essex, The University of Exeter, The University of Glasgow, The University of Hull, The University of Kent, The University of Leeds, The University of Leicester, The University of Liverpool, The University of Nottingham, The University of Stirling, The University of Strathclyde, The University of Surrey, The University of Sussex, The University of Warwick, The University of the West of Scotland, University Campus Suffolk, University of Durham, University of London
9	5	Courtauld Institute of Art, London School of Hygiene and Tropical Medicine, The University of Aberdeen, University College London
10	1	The University of East London
12	3	Aston University, Sheffield Hallam University, The University of Sheffield
13	9	Edinburgh Napier University, Glynd?r University, Oxford Brookes University, The Manchester Metropolitan University, The Robert Gordon University, The University of Central Lancashire, The University of Surrey, University of Abertay Dundee
14	2	The Institute of Cancer Research, The University of Sunderland
16	14	Glasgow School of Art, Imperial College of Science, Technology and Medicine, Institute of Education, The University of Bristol, The University of Edinburgh, The University of Glasgow, The University of Kent, The University of Leeds, The University of St Andrews, The University of Stirling, The University of Strathclyde, The University of Warwick, The University of the West of Scotland, University of Durham
17	1	Heriot-Watt University
18	37	Brunel University, Cardiff University, Courtauld Institute of Art, Edinburgh College of Art, Heythrop College, Imperial College of Science, Technology and Medicine, King's College London, Liverpool Hope University, London Business School, London School of Economics and Political Science, London School of Hygiene and Tropical Medicine, Loughborough University, Middlesex University, Queen Mary University of London, Royal Holloway and Bedford New College, The Open University, The Queen's University of Belfast, The School of Oriental and African Studies, The University of Aberdeen, The University of Birmingham, The University of Cambridge, The University of East London, The University of Hull The University of Keele, The University of Lancaster, The University of Newcastle-upon-Tyne, The University of Reading, The University of Salford, The University of Sheffield, The University of Sussex, The University of York, University College London, University of Ulster, University of the Highlands and Islands
19	1	Glasgow Caledonian University
20	3	Kingston University, The University of Greenwich
26	7	Aston University, Birkbeck College, Royal College of Art, Scottish Agricultural College, The University of Manchester, The University of Oxford, The University of Southampton

Table B1: Generosity of Occupational Maternity Pay across UK HEIs

C Robustness and Outliers

Some of the important explanatory variables exhibit problematic distributions plagued by outliers. For example the RAE score, which we use to measure the research intensity of an institution, has both outliers at the bottom and top end of the distribution – see figure C1. Most HEIs score between 100 and 200. Some institutions received an RAE score of zero because they do not take part in the research assessment exercise or research excellence framework, these 14 institutions are either purely teaching based or teach drama and music, such as the Conservatoire for Dance and Drama, the Courtauld Institute of Art, the Liverpool Institute for Performing Arts, the Royal Agricultural University, the London School of hygiene and Tropical Medicine, or the Royal Veterinary College. One institution, the Institute of Education received an RAE score of 318 in 2008.

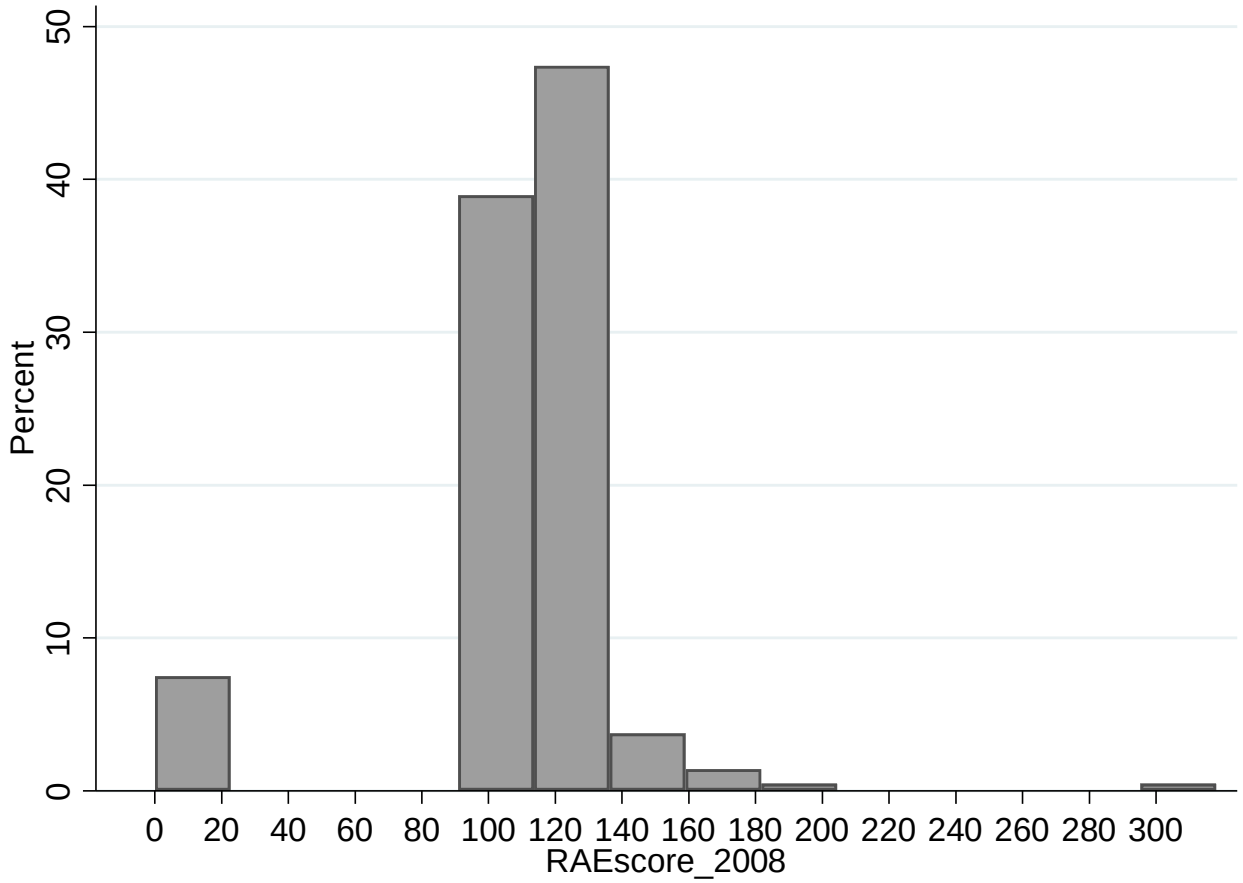

Figure C1: Histogram - RAE score

In addition the share of female professors with respect to all employees is skewed and only two institutions (Courtauld Institute of Art and the Institute of Education) have a share of 0.04. All other institutions have shares between 0 and 0.025.

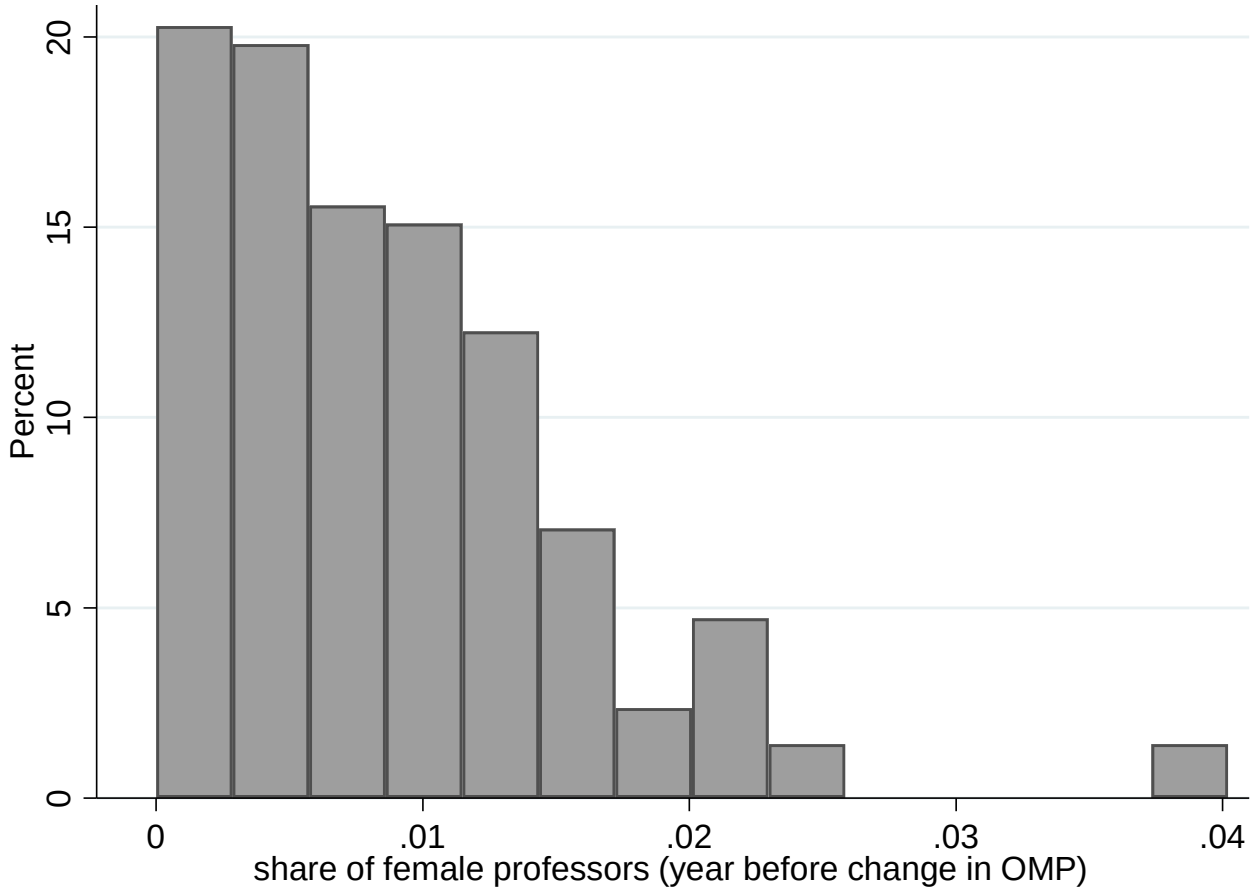

Figure C2: Histogram - share of female professors

Only two institutions (the London School of Hygiene and Tropical Medicine and the Institute of Cancer Research) have a disproportionally large (25 percent) share of female academics at childbearing age.

We exclude these outliers from the analysis and estimate the baseline models (see 4) again, in order to understand whether our findings are driven by these outliers. The results are shown in table C1 and figure C4. The overall findings remain stable to the inclusion/ exclusion of outliers, especially regarding the share of female professors, the research intensity of a university and the share of female academics at child bearing age, even though significance levels for the latter effect drop slightly.

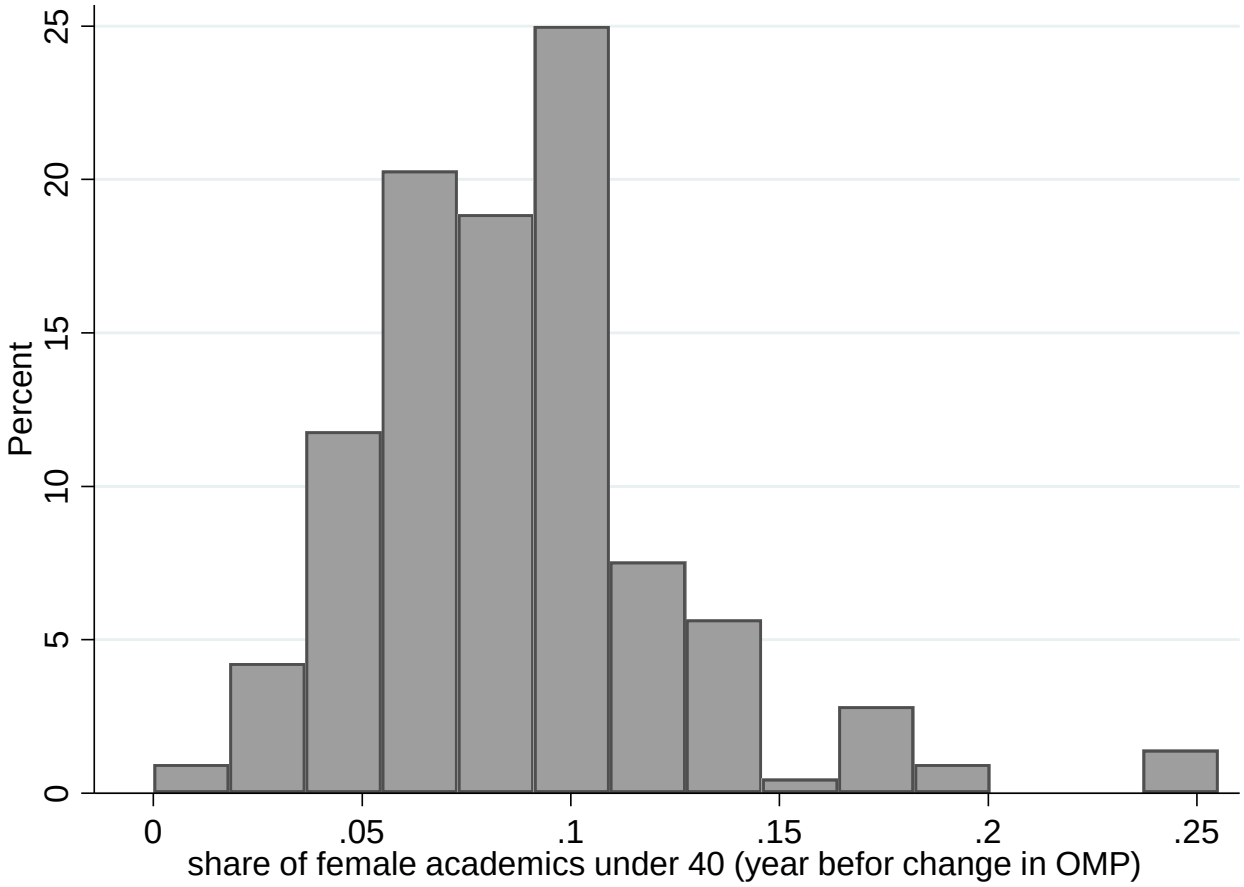

Figure C3: Histogram – share of female academics below the age of 40

Finally, we examine whether the year in which the potentially endogenous explanatory variables are measured change the estimation results. Models 1, 2, and 3 in table C2 use the same specification as our baseline model but measure the relevant right-hand-side variables in the years 2006, 2005, and 2004 – all prior to the last major changes in statutory benefits. Models 4 and 5 show results with measurements for the right-hand-side

DV: Weeks of Full Salary Replacement	1 Negbin	2 Poisson	3 OLS
Total staff in 1000s (BC OMP)	0.104***	0.094**	1.126**
	(0.040)	(0.040)	(0.467)
Ratio ac/admin females (BC OMP)	-0.307*	-0.268	-1.463
	(0.179)	(0.169)	(0.942)
Share of female professors (BC OMP)	29.719***	1.185***	311.379***
	(10.120)	(9.243)	(98.505)
Female academics under 40 (BC OMP)	3.259	2.988*	16.079
	(2.037)	(1.855)	(16.525)
Ratio staff costs/ income (2013)	-0.013	-0.012	-0.144*
	(0.008)	(0.010)	(0.084)
Income research grants (in mill. £ 2013)	-0.002	-0.001	-0.001
	(0.001)	(0.001)	(0.011)
Total income in mill. £ (20130	-0.000	-0.000	-0.008
	(0.001)	(0.000)	(0.007)
Student to staff ratio (BC OMP)	-0.002	0.001	0.017
	(0.013)	(0.014)	(0.109)
RAE score (2008)	0.015***	0.014***	0.163***
	(0.003)	(0.003)	(0.038)
Different packages	-0.458***	-0.469***	-4.864***
	(0.077)	(0.075)	(0.665)
Scotland	0.399***	0.309***	3.388***
	(0.113)	(0.106)	(1.197)
Northern Ireland	0.454**	0.457***	5.424**
	(0.189)	(0.158)	(2.257)
Wales	0.044	-0.066	0.103
	(0.231)	(0.174)	(1.720)
Intercept	1.175**	1.199*	-1.342
	(0.573)	(0.704)	(6.531)
N	191	191	191
R^2 (Pseudo)	0.083	0.227	0.463
Alpha	0.165		

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01

Table C1: Estimation Results Excluding Outliers

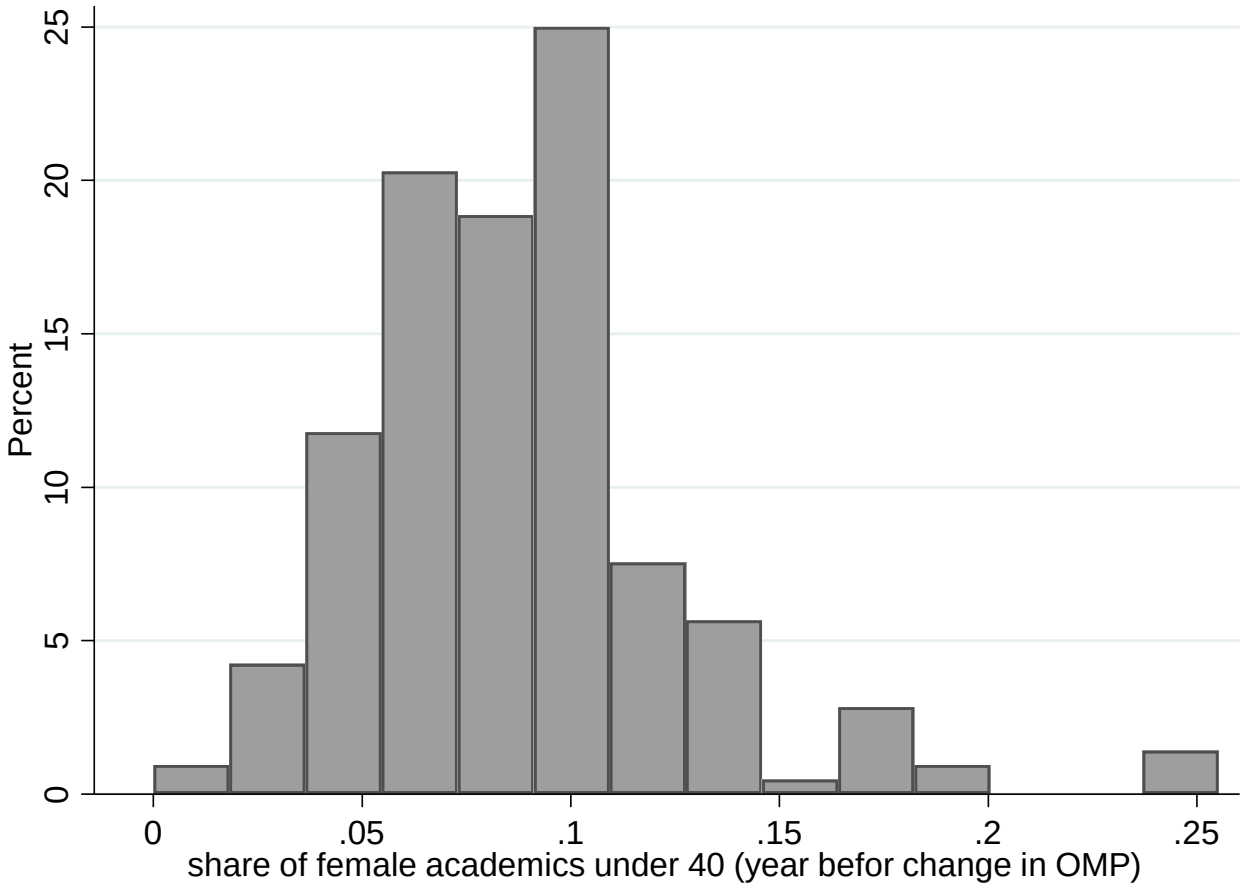

Figure C4: Predicted Weeks of Full Salary Replacement Excluding Outliers

variables in 2006 and with the alternative specifications of the dependent variable (weeks with full time equivalent pay and weeks with partial and full salary replacement).

DV: Weeks of Full Salary Replacement	2006 Negbin	2005 Negbin	2004 Negbin	2006 FT-equivalent	2006 weeks SR
Total staff in 1000s	0.093**	0.084**	0.078*	0.025**	0.001
	(0.037)	(0.041)	(0.044)	(0.011)	(0.028)
Academic to admin females ratio	-0.261	-0.162	-0.032	-0.099	-0.145
	(0.207)	(0.212)	(0.180)	(0.068)	(0.107)
Share of female profs	30.631***	32.706***	33.260***	7.131***	6.621
	(8.841)	(8.533)	(9.009)	(2.390)	(4.327)
Female academics under 40	4.131**	2.226	1.544	1.264**	2.150
	(1.719)	(1.745)	(1.647)	(0.550)	(1.376)
Staff costs to income ratio (2013)	-0.006	-0.030**	-0.029**	-0.000	0.008
	(0.009)	(0.013)	(0.013)	(0.003)	(0.009)
Income research grants in mill. £ (2013)	-0.002	-0.002	-0.002	-0.000	-0.000
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Total Income in mill. £ (2013)	0.000	0.001	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Student to staff ratio	-0.024*			-0.006	-0.003
	(0.013)			(0.004)	(0.010)
RAE score (2008)	0.005***	0.005**	0.005**	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Different packages	-0.443***	-0.448***	-0.428***	-0.103***	0.038
	(0.075)	(0.075)	(0.078)	(0.028)	(0.060)
Scotland	0.394***	0.397***	0.407***	0.097***	0.076
	(0.122)	(0.119)	(0.119)	(0.032)	(0.079)
Northern Ireland	0.384**	0.441***	0.473***	0.050	-0.149
	(0.181)	(0.170)	(0.163)	(0.040)	(0.190)
Wales	-0.002	-0.010	0.017	0.067	0.014
	(0.162)	(0.155)	(0.148)	(0.064)	(0.142)
Intercept	2.163***	2.216***	2.200***	2.866***	2.290***
	(0.511)	(0.500)	(0.486)	(0.146)	(0.435)
N	209	206	203	209	209
R^2 (Pseudo)	0.084	0.088	0.084	0.048	0.013
Alpha	0.184	0.169	0.179	0.000	0.101

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01

Table C2: Different RHS Years and Alternative DVs

The results in table C2 largely confirm the findings in the baseline model as well as the models with alternative specifications of the dependent variable. Since the bulk of changes in occupational maternity benefits occurred between 2008 and 2012 the measures from 2006 seem to best account for the implemented changes in occupational maternity packages. This confirms our expectations that the process of consultation regarding changes in occupational maternity happens shortly before new maternity provisions are issued by a university. If we move further into the past (2005, 2004) some of the effects lose statistical significance, e.g. the share of female academics at child bearing age. However, the overall effects remain remarkably stable, adding to the notion that our findings are robust towards different specifications and inclusion of variables.

D Multicollinearity and Endogeneity of Institutional Income measures

Right-hand-side variables – measured in the year before last changes in OMP	Variance inflation factor	Tolerance
Total income in mill £ (2013)	28.81	0.035
Total number of staff	12.89	0.078
Income research grants in mill. £ (2013)	10.96	0.091
Share of female academics under 40	2.40	0.416
Ratio of female academic/admin staff	1.65	0.608
Student to staff ratio	1.61	0.622
Share of female full professors	1.53	0.654
Staff costs per income (2013)	1.30	0.767
RAE Score 2008	1.28	0.782
Different packages	1.20	0.833
Scotland	1.09	0.916
Wales	1.06	0.942
Northern Ireland	1.05	0.952

Table D1: Variance Inflation Factor for RHS Variables in the Baseline Model

The variables closely related to the wealth or size of an institution, total income, number of staff, and income generated by research grants have the highest variance inflation factor indicating higher order correlation between these three measures and such potentially high multicollinearity which leads to inefficient estimation and might prevent identifying the effect of each of these factors. This is supported by the correlation between these three variables: the Pearson correlation coefficient for total income and research income is 0.93, for total number of staff and total income 0.95, and for total number of staff and income generated from research grants 0.84. We therefore run models including only one of the three variables on the right-hand-side to check the robustness of the Null-finding for wealth of the institution. Results can be found in table D2 below:

Separating out these 3 variables has no effect on the previously discussed results. Total income when included alone only becomes very marginally statistically significant.

DV: Weeks of Full Salary Replacement	1 Negbin	2 Negbin	3 Negbin
Total staff in 1000s (BC OMP)	0.048**		
	(0.023)		
Acad. to adm. females ratio (BC OMP)	-0.427**	-0.451**	-0.430**
	(0.172)	(0.186)	(0.182)
Share of female profs (BC OMP)	29.104***	31.465***	30.127***
	(7.293)	(7.492)	(7.363)
Female academics under 40 (BC OMP)	3.275**	3.872***	3.493**
	(1.426)	(1.468)	(1.445)
Staff costs/income ratio (2013)	-0.002	-0.000	0.000
	(0.008)	(0.009)	(0.009)
Income research grants in mill. £ (2013)		0.001	
		(0.001)	
Total income in mill. £ (2013)			0.000*
			(0.000)
Student to staff ratio (BC OMP)	-0.016	-0.014	-0.015
	(0.013)	(0.015)	(0.014)
RAE score (2008)	0.004***	0.005***	0.005***
	(0.002)	(0.002)	(0.002)
Different packages	-0.471***	-0.444***	-0.456***
	(0.073)	(0.069)	(0.070)
Scotland	0.345***	0.322***	0.338***
	(0.107)	(0.101)	(0.104)
Northern Ireland	0.379**	0.367**	0.375**
	(0.180)	(0.184)	(0.181)
Wales	-0.038	-0.054	-0.040
	(0.204)	(0.194)	(0.196)
Intercept	2.158***	1.991***	2.021***
	(0.459)	(0.488)	(0.478)
N	208	208	208
R^2 (Pseudo)	0.080	0.075	0.077
Chi^2	149.099	164.222	156.161
P_value (Chi^2)	0.000	0.000	0.000
Alpha	0.188	0.198	0.193

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01, BC OMP = year before the last Change in Occupational Maternity Package

Table D2: Robustness Check for Institutional Income

DV:	Total staff in 1000s	Staff costs/ income ratio	Income research in mill. £	RAE score
Total Income in mill. £	0.011***	-0.000	0.322***	0.051***
	(0.000)	(0.002)	(0.009)	(0.011)
Partial R^2	0.897	0.000	0.874	0.100
N	208	209	209	209

Table D3: Income and other Institutional Variables (OLS)

E Including Spatial Lags

In appendix E, we further investigate the peer group effect and potential inter-dependence of maternity packages by employing a spatial lag specification.
In the UK, universities have self-selected into formal and informal associations according to their research activities, teaching aims, research grants, contract income and entry requirements, *inter alia*. For example, the Russell Group, founded in 1994 and based in London, is arguably the most known HEIs association comprising of 24 universities, but many other formal and informal university grouping exist in the UK. The purpose of these affiliations is to represent the interests of member institutions and promote their shared values. [47] Albeit with some differences, group membership thus signals similarities between affiliated institutions. For example, the Million+ Group [48] specializes in courses on modern subjects and professional qualification while the Russell Group or the 1994 group [49] are more centred on traditional subjects.[50]

The self-selection of universities into groups is likely to affect the generosity of maternity schemes since the benefits granted by one institution are not necessarily independent of maternity benefits granted by other peer institutions. We add spatial lags into the empirical specification to test for this possibility. The results of the spatial lag specification are presented in table E1. We generate spatial lags of the dependent variable weighted by membership in a specific university group (e.g. Russell Group, Golden Triangle, New Universities, Northern Consortium etc.). This implies that when a University contemplates changing occupational maternity benefits they take into account what other institutions in their peer group have implemented. Hence this models directly the interdependence of maternity benefits across observations (institutions). We run spatial lag models with an OLS and a Negative Binomial Specification. Our findings strongly support the findings in the generalized binomial specification presented in the main text in table 4, model 4. We find that member institutions of the Golden Triangle group are likely to improve their provisions if other members do so as well (a positive significant spatial effect) while post 1992 institutions, which are much more diverse, are likely to lower their provisions in response to other members of the same group. In addition, and also consistent with previous results, Scottish universities tend to improve benefits if other institutions in Scotland do so as well. All other findings remain robust to this spatial specification.

DV: Weeks of Full Salary Replacement	OLS	Negbin
Weighted Spatial lag Russell Group	-0.008	0.001
	(0.101)	(0.009)
Weighted Spatial lag Golden Triangle	0.240***	0.019**
	(0.091)	(0.008)
Weighted Spatial lag Group 94	-0.006	-0.000
	(0.138)	(0.011)
Weighted Spatial lag New '92 former polytechnics	-0.329**	-0.029
	(0.158)	(0.019)
Weighted Spatial lag New '92 non- polytechnics	-0.916***	-0.123**
	(0.317)	(0.049)
Weighted Spatial lag Beloff's plateglass, original	-0.129	-0.014
	(0.146)	(0.011)
Weighted Spatial lag Beloff's plateglass, other	0.095	0.009
	(0.104)	(0.009)
Weighted Spatial lag Redbrick	0.017	0.002
	(0.145)	(0.011)
Weighted Spatial lag Cathedrals Group	0.165	0.048
	(0.237)	(0.038)
Weighted Spatial lag GuildHE	0.115	-0.018
	(0.281)	(0.042)
Weighted Spatial lag Million Plus Modern Universities	0.220	0.019
	(0.136)	(0.019)
Weighted Spatial lag 2006 University Alliance	0.252	0.034**
	(0.154)	(0.016)
Weighted Spatial lag Northern Consortium UK	0.087	0.005
	(0.133)	(0.010)
Weighted Spatial lag Universities of Scotland	0.218**	0.024***
	(0.097)	(0.009)
Total staff in 1000s (BC OMP)	0.785*	0.063
	(0.471)	(0.043)
Acad. to adm. females ratio (BC OMP)	-2.786***	-0.482***
	(0.734)	(0.146)
Share of female profs (BC OMP)	268.769***	25.881***
	(67.587)	(7.584)
Female academics under 40 (BC OMP)	20.814*	3.772***
	(10.757)	(1.321)
Staff costs/income ratio (2013)	-0.089	-0.010
	(0.084)	(0.011)
Income research grants in mill. £ (2013)	-0.001	-0.001
	(0.015)	(0.001)
Total income in mill. £ (2013)	-0.006	-0.000
	(0.006)	(0.000)
Student to staff ratio (BC OMP)	-0.005	-0.004
	(0.119)	(0.015)
RAE score (2008)	0.032**	0.004**
	(0.013)	(0.002)
Different packages	-5.054***	-0.461***
	(0.696)	(0.075)
Intercept	13.908***	2.592***
	(4.917)	(0.598)
N	208	208
R2 (Pseudo)	0.495	0.102
Chi^2		305.286
P_value (Chi^2)		0.000
Alpha		0.141

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01, BC OMP = year before the last Change in Occupational Maternity Package

Table E1: Baseline Model including Spatial Lags of the Main Dependent Variable Weighted by University Group Membership

F Union Density, Robustness

DV: Weeks of Full Salary REplacement	Negbin	Negbin	Negbin	Negbin
Total staff in 1000s (BC OMP)	0.107***	0.098**	0.083*	0.097*
	(0.039)	(0.040)	(0.047)	(0.051)
Acad. to adm. females ratio (BC OMP)	-2.063**	-1.347	-1.884*	-1.724
	(1.003)	(0.932)	(0.970)	(1.073)
Share of female profs (BC OMP)	-0.622***	-0.543***	-0.552***	-0.532***
	(0.162)	(0.156)	(0.161)	(0.163)
Female academics under 40 (BC OMP)	7.026***	6.600***	0.873***	2.806***
	(9.137)	(9.884)	(6.470)	(6.116)
Staff costs/income ratio (2013)	7.181***	5.051***	4.231***	4.307***
	(1.973)	(1.772)	(1.449)	(1.534)
Income research grants in mill. £ (2013)	-0.003	-0.008	-0.003	-0.009
	(0.013)	(0.009)	(0.010)	(0.008)
Total income in mill. £ (2013)	-0.003**	-0.002**	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
student To staff ratio (bc OMP)	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
RAE score (2008)	0.001	-0.005	-0.012	-0.016
	(0.016)	(0.014)	(0.013)	(0.014)
Different packages	0.004*	0.004*	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Scotland	-0.466***	-0.452***	-0.452***	-0.464***
	(0.075)	(0.074)	(0.073)	(0.080)
Northern Ireland	0.244**	0.354***	0.313***	0.361***
	(0.107)	(0.112)	(0.112)	(0.110)
Wales	0.444***	0.443***	0.366**	0.378**
	(0.164)	(0.154)	(0.169)	(0.173)
Intercept	-0.222**	0.006	-0.076	-0.026
	(0.100)	(0.214)	(0.216)	(0.225)
UCU density 2007	-0.748**			
	(0.377)			
UCU density 2013		-0.780***		
		(0.284)		
UCU density 2015			-0.487	
			(0.312)	
UCU density 2018				-0.114
				(0.324)
Intercept	3.139***	3.269***	3.408***	3.492***
	(0.858)	(0.710)	(0.739)	(0.735)
N	186	194	207	197
R^2 (OLS)	0.491	0.485	0.465	0.457
R^2 (Pseudo)	0.095	0.095	0.088	0.087
Chi^2	264.662	274.919	254.093	252.623
P_value (Chi^2)	0.000	0.000	0.000	0.000
Alpha	0.147	0.148	0.170	0.163

Robust Standard Errors in Parentheses, * p≤0.1, ** p≤0.05, *** p≤0.01

Table F1: Robustness Check for Union Density Measured in Different Years

G Membership in University Groups and Consortia

Russell Group University of Birmingham, University of Bristol, University of Cambridge, Cardiff University, Durham University, University of Edinburgh, University of Exeter, University of Glasgow, Imperial College London, King's College London, University of Leeds, University of Liverpool, London School of Economics and Political Science, University of Manchester, Newcastle University, University of Nottingham, University of Oxford, Queen Mary University of London, Queen's University Belfast, University of Sheffield, University of Southampton, University College London, University of Warwick, University of York
2. Golden Triangle (informal) University of Cambridge, Imperial College London, King's College London, London School of Economics and Political Science, University of Oxford, University College London, (London Business School, London School of Hygiene and Tropical Medicine)
1994 Group (dissolved in 2013) Birkbeck, University of London, University of East Anglia, University of Essex, Goldsmiths - University of London, Institute of Education - University of London, University of Lancaster, University of Leicester, Loughborough University, Royal Holloway - University of London, SOAS - University of London, University of Sussex
New Universities (post 1992 – former polytechnics and central institutions) (informal) Anglia Ruskin University, Birmingham City University , Bournemouth University, University of Brighton, University of Central Lancashire, Coventry University, De Montfort University, University of East London, University of Greenwich, University of Hertfordshire, University of Huddersfield, Kingston University, Leeds Beckett University, University of Lincoln, Liverpool John Moores University, London Metropolitan University, London South Bank University, Manchester, Metropolitan University, Middlesex University, Northumbria University, Nottingham Trent University, Oxford Brookes University, University of Plymouth, University of Portsmouth, Sheffield Hallam University, University of South Wales, Staffordshire University, University of Sunderland, Teesside University, University of the West of England, University of West London, University of Westminster, University of Wolverhampton, University of Abertay Dundee, Edinburgh Napier University, Glasgow Caledonian University, The Robert Gordon University, University of the West of Scotland
New Universities (post 1992, not former polytechnics) Arden University, University of the Arts London, The Arts University Bournemouth, Bath Spa University, University of Bedfordshire, University College Birmingham Bishop Grosseteste University, University of Bolton, BPP University, Buckinghamshire New University, Canterbury Christ Church University, Cardiff Metropolitan University, University of Chester, University of Chichester, University for the Creative Arts, University of Cumbria, University of Derby, Edge Hill University, Falmouth University, University of Gloucestershire, Glyndŵr University, Harper Adams University, University of the Highlands and Islands, University of Law, Leeds Trinity University, Liverpool Hope University, Newman University, University of Northampton, Norwich University of the Arts, Queen Margaret University, University of Roehampton, Regent's University London, Royal Agricultural University, Southampton Solent University, University of St Mark & St John, St Mary's University, Twickenham, University of Suffolk, University of Winchester, University of Worcester, York St John University
Beloff's plateglass universities (informal), (original) University of East Anglia, University of Essex, University of Kent, Lancaster University, University of Sussex, University of Warwick, University of York
Beloff's plateglass universities (informal), (other) Aston University, University of Bath, University of Bradford, Brunel University, University of Buckingham, City, University of London, Heriot-Watt University, Keele University, Loughborough University, Newcastle University, Open University, University of Salford, University of Dundee, University of Stirling, University of Strathclyde, University of Surrey, Ulster University
Redbrick Universities (informal) University of Birmingham, University of Liverpool, University of Manchester, University of Leeds, University of Sheffield, University of Bristol, University of Reading, University of Nottingham, Newcastle University
Cathedrals Group (officially the **Council of Church Universities and Colleges** or **CCUC**) Bishop Grosseteste University, Canterbury Christ Church University, University of Chester, University of Chichester, University of Cumbria, University of Gloucestershire, Heythrop College, University of London, Leeds Trinity University, Liverpool Hope University, Newman University, University of St Mark & St John, Roehampton University, St Mary's University (Twickenham), University of Wales, Trinity Saint David, University of Winchester, York St. John University
GuildHE **Full Members**: Abertay University, Arts University Bournemouth, Bath Spa University, Bishop Grosseteste University Lincoln, Buckinghamshire New University, Falmouth University, Harper Adams University, Leeds College of Art, Leeds Trinity University, Newman University, Norwich University of the Arts, Plymouth College of Art, Ravensbourne, Rose Bruford College, Royal Agricultural University, Royal Central School of Speech and Drama, Southampton Solent University, St. Mary's University College (Belfast), St. Mary's University College (Twickenham), The Anglo-European College of Chiropractic, The British School of Osteopathy, The Liverpool Institute for Performing Arts, The University of Law, University College Birmingham, University for the Creative Arts, University of Chichester, University of St Mark & St John, University of Suffolk, University of Winchester, University of Worcester, Writtle University College, York St John University **Associate Members:** Academy of Live Recorded Arts (ALRA), Bradford College, British and Irish Modern Music Institute, Cleveland College of Art and Design, GSM London, Hartpury College, Hereford College of Arts, The Institute of Contemporary Music Performance, SAE Institute, UCFB
MillionPlus = Coalition of Modern Universities (1997) Abertay University, Anglia Ruskin University, Bath Spa University, University of Bedfordshire, University of Bolton, Canterbury Christ Church University, University of Cumbria, University of East London, Edinburgh Napier University, University of the Highlands and Islands, Leeds Trinity University, London Metropolitan University, London South Bank University, Middlesex University, Southampton Solent University, Staffordshire University, University of Sunderland, University of West London, University of the West of Scotland
University Alliance (2006) Coventry University, Kingston University, Liverpool John Moores University, Manchester Metropolitan University, Nottingham Trent University, Oxford Brookes University, Sheffield Hallam University, Teesside University, The Open University, University of Brighton, University of Central Lancashire, University of Greenwich, University of Hertfordshire, University of Huddersfield, University of Portsmouth, University of Salford, University of South Wales, University of the West of England
NCUK (Northern Consortium) The University of Bradford, The University of Huddersfield (then as Huddersfield Polytechnic), Leeds Beckett University (then as Leeds Polytechnic), The University of Leeds, Liverpool John Moores University (then as Liverpool Polytechnic), The University of Liverpool (partnership ended), Manchester Metropolitan University (then as Manchester Polytechnic), The University of Manchester, The University of Salford, Sheffield Hallam University (then as Sheffield Polytechnic), The University of Sheffield, Aston University, The University of Birmingham, University of Bristol, Queen Mary University of London, University of Kent, Kingston University London
Universities Scotland University of Aberdeen, Robert Gordon University, Abertay University, University of Dundee, University of Edinburgh, Edinburgh Napier University, Heriot-Watt University, Queen Margaret University, University of Glasgow, Glasgow Caledonian University, Glasgow School of Art, Royal Conservatoire of Scotland, University of Strathclyde, University of St Andrews, University of Stirling, Open University in Scotland, Scotland's Rural College, University of the Highlands and Islands, University of the West of Scotland

Table G1: University Groups

H Derivation of the Negative Binomial and Generalized Negative Binomial Estimators

In appendix H we derive the estimators for our preferred empirical specification. The negative binomial estimator models the number of occurrences or counts of an event when the event has extra-Poisson variation, that is, when it has over-dispersion. The Poisson regression model can be formally described as follows

$$y_j \sim Poisson(\mu_j)$$

where

$$\mu_j = exp(x_j\beta + offset_j)$$

for observed counts y_j with covariates x_j for the jth observation. One can derive the negative binomial mean-dispersion model with individual units following a Poisson regression model, but there is an omitted variable η_j, such that e^{η_j} follows a gamma distribution with mean 1 and variance α:

$$y_j \sim Poisson(\mu_j^\star)$$

where

$$\mu_j^\star = exp(x_j\beta + offset_j + \eta_j)$$

and

$$e^{\eta_j} \sim Gamma(1/\alpha, \alpha)$$

With this parameterization, a $Gamma(a; b)$ distribution will have expectation ab and variance ab^2. We refer to α as the overdispersion parameter. The larger α is, the greater the overdispersion. The Poisson model corresponds to $\alpha = 0$. The negative binomial model parameterizes α as $ln(\alpha)$. The generalized negative binomial estimator allows $ln\alpha$ to be modeled as $ln(\alpha_j) = z_j$, a linear combination of covariates z_j.

The negative binomial estimator can fit two different parameterizations of the negative binomial model. The first has dispersion for the jth observation equal to $1 + \alpha exp(x_j\beta + offset_j)$. This is seen by noting that the above implies that

$$\mu_j^\star \sim Gamma(1/\alpha, \alpha\mu_j)$$

and thus

$$\begin{aligned} Var(y_j) &= E\{Var(y_j|\mu_j^\star)\} + Var\{E(y_j|\mu_j^\star)\} \\ &= E(\mu_j^\star) + Var(\mu_j^\star) \\ &= \mu_j(1 + \alpha\mu_j) \end{aligned}$$

The alternative parameterization models dispersion equal to $1 + \delta$; so that it is constant for all observations, because the constant-dispersion model assumes instead that

$$\mu_j^\star \sim Gamma(\mu_j/\delta, \delta)$$

and thus $Var(y_j) = \mu_j(1 + \delta)$. The Poisson model corresponds to $\delta = 0$.

For detailed derivations of both models, see Cameron and Trivedi (2013, 80–89). In particular, note that the mean-dispersion model is known as the NB2 model in their terminology, whereas the constant-dispersion model is referred to as the NB1 model. In our specifications we use the mean-dispersion model throughout but the results remain fully robust to a constant-dispersion specification.